Surgery of Repair

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PRINCIPLES, PROBLEMS, PROCEDURES

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Abdomen (Abdereplasty)

Plastic surgery of the abdomen may be divided into two categories *parietoplastics* and *visceroplastics* The former has to do with the reconstruction of the abdominal wall whereas the latter deals with such reconstructive procedures as apply to the abdominal organs and their appendages Visceroplasties may be subdivided into *gastroplastics hepatoplastics nephroplastics enteroplastics* etc Parietoplasties may be subdivided into *esthetic prosthetic* and *kinematic* Esthetic parietoplasties constitute for the most part conditions marked by superficial scars of the abdominal wall tissue excisions and defacements due to tattoos pigmentations fatty aprons and congenital afflictions of the skin and subcutaneous tissue The prosthetic parietoplasties concern themselves with conditions marked by tissue voids such as unusually large hernias (postoperative or congenital) and extensive healed gunshot wounds The kinematic parietoplasties concern themselves *with conditions of tissue derangement* often in combination with voids where direct musculofascial reconstruction is possible and hence over all functional restitution of the abdominal wall attainable This is predicated on no nerve injury

As has been indicated in the chapter Surgical Geometrics there may be a direct relationship between the nature and the extent of a surgical incision and the resultant postoperative abdominal defect Such defects when they occur are often the result of the erroneous assumption that the closure of an incision is but a simple mechanical inversion of the making of the incision

The still prominent percentage of post operative tissue derangements scars and hernias which follow conventional types of abdominal incisions are but witness and proof of the fact that some interrelationship exists between the making of the conventional forms of abdominal incisions and their closure The standard abdominal incision is based upon ease of physical access to intra abdominal pathology This is frequently contrary to anatomic and physiologic conditions inherent in the abdominal wall It is one of the three major reasons for the relative frequency of postoperative hernias the other two being lack of proper splinting (viz suturing) and infection

The more physiologic abdominal incisions which guarantee assurance against the pulling of sutures and the disruption of the wound is one of the cardinal necessities of modern surgery Sutures hold best where they pull across tissue fibers This can only be accomplished by planning the incision *so that it runs parallel with the tissue fibers* Insofar as this applies to the skin of the abdomen it involves knowledge of Langer s lines of tension (Fig 211)

One of the greatest objections to the transverse abdominal incisions has been the argument that they necessitate cutting across the abdominal muscles when as a matter of fact this only involves one abdominal muscle and that is the rectus In the resuturing of a cut the muscle sutures *hold poorly pull out easily* and result in muscle diastasis Coincidentally little or no attention is given the fact that most vertical abdominal incisions though sparing the rectae physically invalidate them physio

logically by cutting their nerve supply A paralyzed muscle is a functionally dead muscle It is, additionally, apparent that adequately accomplished by proper splinting of the abdomen To this end it is helpful to keep the patient in a semireclining posi

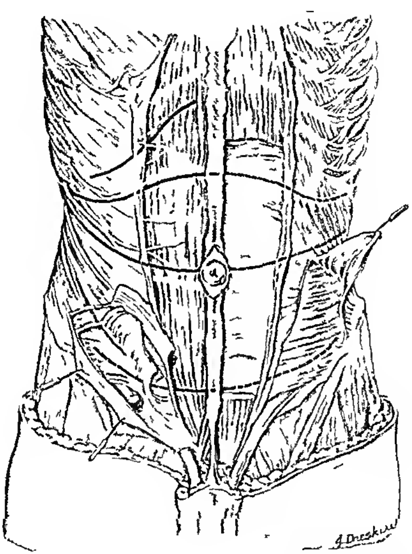

FIG 211 Allocation of physiologic abdominal incisions Note that the only abdominal muscle actually cut by a horizontal incision is the rectus The ultimate physiologic equitability of transverse abdominal incisions lies in conservation of the fascial investments of the abdomen, especially the endo abdominal fascia, and the maximum conservation of muscle innervation

the accurate resuturing of abdominal muscles is not as important as meticulous repair of the investing fascias The approximation of the muscle edges is quite tion with the knees somewhat flexed (Fig 212)

Some guidance to the proper planning of abdominal incisions the avoidance of post

operative herniation and the best methods of repair may be gleaned from a review of the anatomy of the abdominal wall

SURGICAL ANATOMY

At the outset it must be recalled that any incision which cuts across the nerve supply of a muscle, even though the muscle heals, results in paralysis, lack of function and eventual diastasis Any incision which cuts across the main blood supply of a muscle results in delayed or absent healing with necrosis and retraction and so establishes a kinematic tissue void which may ultimately lead to postoperative herniation

For purposes of anatomic review and surgical approach, the abdomen may be divided into two parts the upper and the lower, the umbilicus acting as the approximate point of division between the two The upper abdominal wall is tense firm and strong due to the costal attachments of the muscles and the fascia and their lateral pull is the result of the distribution of the fascial fibers This is one of the main reasons why vertical incisions in the upper abdomen are always difficult to close When such closures open spontaneously after operation it will usually be found that the resultant defect runs in a horizontal direction This is

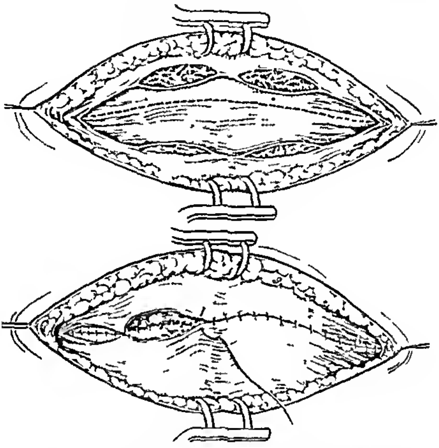

FIG 212 (*Top*) Transverse severance of rectus muscles Broken line indicates contemplated incision in endo abdominal fascia (*Bottom*) From left to right closure of endo abdominal fascia suturing of posterior rectus sheath, and closure of anterior rectus sheath Note that no sutures are used for direct muscle approximation Adequate reconstruction of the fascial investments is sufficient to guarantee proper healing of rectus muscles

strictly apropos the normal lines of tension in the fascias of the upper abdomen

The aggregate of the lines of pull and the tension in the lower abdomen are for the most part in a more or less oblique direction Due to the lack of the prominent linea transversae in the lower abdomen as contrasted with the upper, the linea alba is much weaker The rectus muscles, not having the support of the transverse fibrous intersections are more prone to bulge and separate after injury Not until one reaches the lowermost portion of the abdomen do the rectus muscles and their investments again find additional support This support is contributed by the pyramidalis muscles and their fibrous fusion with the linea alba on the one hand and the reflections of the inguinal ligaments on the other (Fig 211)

Hence the making of an abdominal incision and its repair should follow these established anatomic inherencies of the abdominal wall The foregoing may be summarized by saying that given a restricted portion of the abdominal wall applying an incision contrary to the lines of tension of its components and closing such an incision by simple direct approximation one can easily visualize the tissue results which will ensue in the course of healing and the postoperative complications which may result when the intra abdominal contents are thrown against the repair in the upright position These problems become doubly important in view of the contemporary tendency toward early ambulation of the patients Since any incision must needs be a mechanical cellular injury to tissues it should at one and the same time avoid gross anatomic insult to the part If an incision or injury contrary to the structural integrity of the part cannot be avoided the only solution to the problem lies in the proper reconstructive closure of the abdominal wall even though this may necessitate more than simple mechanical approximation of the tissues This reiterates the importance of the principle laid down in a former chapter, namely, that the closure of an incision is not necessarily a simple reversal of the mode of its creation In fact, the incision itself may be the primary reason for the necessity of a reconstructive closure of the abdomen

The *ideal abdominal incision is not always possible* of application and frequently it is impractical for mechanical operative reasons In fact some part or level of almost any extensive incision is contrary to the anatomic peculiarities of a part This phase of the incision should receive special attention in the ultimate closure This qualitative discernment in the closure of incisions and the specific repair of its gross anatomic dissolutions rather than the over all physical apposition of the divided tissues en masse is what determines adequate repair

PARIETOPLASTIES

Voids

Total voids of the abdominal parietes may be congenital or traumatic Both are usually inconsistent with life The former because of other associated conditions such as a craniorachischisis and the latter because of acute blood loss shock and extensive intra abdominal injuries

Partial voids of the abdominal wall may be subdivided into superficial deep and perforating

They are made up of conditions attended by tissue loss or lack consequent upon extensive fibrosis in connection with old hernias excisions of parts of the abdominal wall in connection with the extirpation of adherent intra abdominal malignancies extensive gunshot wounds, neoplasms of the peritoneum or fascias and muscles of the abdominal wall proper (Fig 212) The basis of repair in all such conditions rests on the fact that no tissue is present in the void, hence it must be brought in in accord

ance with the principles of tissue shifting transportation or grafting

Methods of Reconstruction

SUPERFICIAL VOIDS Tissue voids involving the outermost covering of the abdominal wall are seldom a problem The skin and subcutaneous tissue of the abdomen are normally present in adequate amounts have a high degree of elasticity and are easily transposed in large amounts without the fear of subsequent functional interference or formative distortion

Fortunately for the abdominal surgeon the skin losses most amenable to easy repair are such as occur in the abdominal midline These reconstructions are for the most part linear in nature (See Chap 21 Surgical Geometrics) This is more true and more easy of accomplishment in the lower abdomen than the upper abdomen The reconstruction can usually be accomplished by the designing of so-called sliding flaps Some of the more simple methods based upon the principles of surgical geometrics are shown in the attendant illustrations (Fig 213)

Extensive skin and subcutaneous losses in the upper abdomen are not quite as easily repaired as those of the lower abdomen In fact it is not unusual to have to borrow tissues from the lower abdomen or the flanks to avoid undue tension in the closure of upper abdominal wounds To a certain extent this can be avoided by resorting to the author s method of closure of circular defects because a large percentage of upper abdominal voids is of a circular or near circular nature and because the skin of the abdomen is unusually elastic The application of the aforementioned method is particularly adaptable to such abdominal defects (Fig 214)

DEEP VOIDS are comprised by that category of cases where there is absence of any or all of the tissues lying between the peritoneum and the subcutaneous fat Foremost among these in the maintenance of the integrity of the abdominal wall is the transversalis or endo abdominal fascia This layer of tissue is probably the most important in preventing the so called peritoneal bulge particularly in the inguinal region It is also the most difficult to reconstruct because it is thin and has such limited elasticity If the abdominal defect involving this layer of tissue is small enough it may be closed directly and its closure maintained by postoperative relaxation of the abdominal wall through flexion Where the opening is large it may become insurmountable through closure by direct approximation For such cases MacLean recommends splitting of the fibrous ring of the defect thereby creating a potential anterior and posterior rectus layer The portion of the defect containing rectus muscle is then sutured into the wedge created by the split Such a procedure has its limitations if not from the physical standpoint of direct approximation at least from the physiologic standpoint that the repair is based upon the use of fibrous tissue always present in the circumference of the defect Theoretically this should be excised Excision of course makes the void more extensive This immediately places it in the class of voids impossible of closure by any local means

The latter constitutes one of the great problems in reconstructive surgery For a long time it has been the practice to close these openings by fascia taken from the thigh or by a dermic graft mobilized from some other part of the body These are not always satisfactory repairs because unless all of the scar tissue comprising the void is excised the free graft whether it be fascia or dermis is placed into a physiologically unsatisfactory bed This eventually leads to disruption of the fascial graft or a necrosis and dissolution of the dermic graft with recurrence of the abdominal herniation In older patients suffering with hernias an additional physiologic factor inimical to adequate healing is the age of the patient As

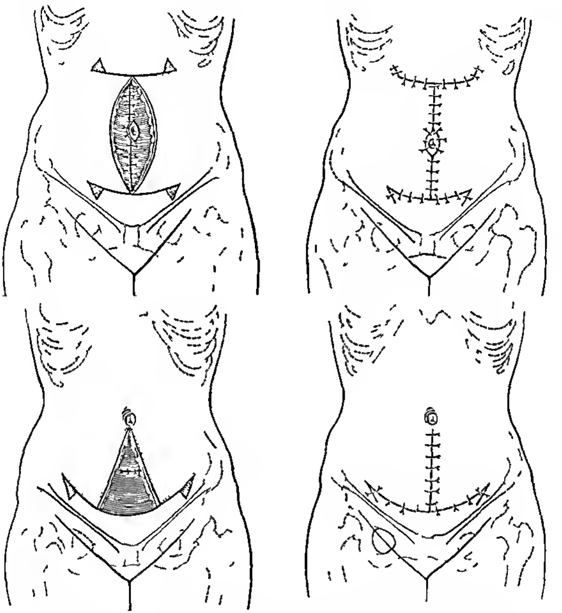

FIG 213 Basic methods of skin closure of abdominal defects by sliding flaps Stippled areas indicate extent of undermining Note triangular excisions of skin and subcutaneous tissue at the extremities of horizontal incisions This is to avoid prominent nippling

R W McNealy states Thus one is frequently taking old fascia from an old thigh and putting it into an old hole in an old man * Although this does not hold true in young patients whose circulation is still adequate the element of fibrous tissue about the defect leads to the same consequences because a fibrous hole is physiologically an old hole which cannot keep pace with the metabolic needs of young grafts any more than an old man can keep

* McNealy R W and Glassman J A Vitallium plates used in repair of large hernias Illinois Med J 90 1 0 173 1946

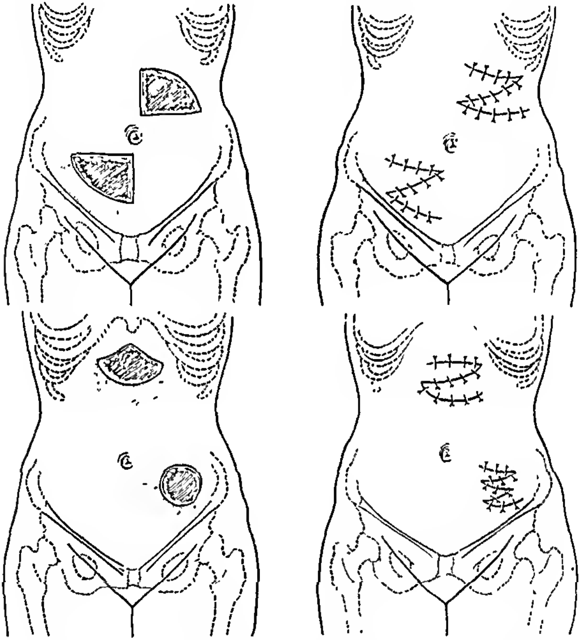

FIG. 214. A method of closure of arched and circular defects as applied to the abdomen (See Chap 21, "Geometrics ")

up with a youngster The fibrous ring of such a defect should be excised if the employment of fascial or dermic free grafts is to bear consistent results.

Because of the importance of the circulatory element in the reconstruction of large abdominal defects, it is far better to mobilize the remains of the anterior rectus sheath in the form of flaps and superimpose one layer upon the other over the defect and then use extraneous fascia or a dermic graft to replace the transposed anterior rectus fascia (Fig 215). Where this is not feasible or possible, R. W McNealy recommends the use of vitallium plates of varying sizes and shapes which are sutured into the defect after closure of the peritoneum and whatever approximation of the endo abdominal

fascia is possible (Fig 215) Such prosthetic repair of the abdominal wall, employing inert extraneous matter, makes its sporadic appearance every few years MacLellander of Norway recommends the use of metal wire netting This type of repair began with inelasticity and tendency to break or fracture postoperatively Many other authors have employed one or another type of wire netting in the repair of large abdominal voids, among them Kirschner, Stackloff, Usadel and Nordmann

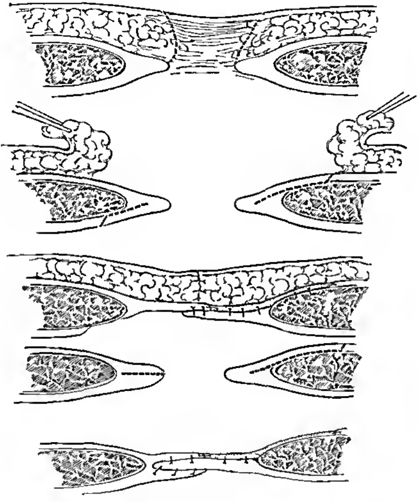

Fig 215 Methods of repair of abdominal midline defects by rotation flaps of rectus fascia and complementary reconstruction by dermic graft Stippled areas indicate region of dermic graft

Goepel in 1928 He used so called ring netting which consisted of a wire mesh composed of larger rings connected to each other within the larger rings were smaller rings connected among themselves This type of contrivance avoids one cardinal objection to ordinary wire netting, that is, its

On the basis of time proven surgical principles and extensive experiences with metals in World War II, it would seem that these tempting practices might better be superseded by more extended knowledge of plastic procedures by the general surgeon Such interim pseudophysiologic procedures

invariably precede a search for and final solution of these problems by methods more physiologic

As was stated in a previous chapter there is no substitute for living tissue Even poor living tissue in any large number of cases, will usually prove to be better than the best foreign material One of the ways of avoiding or obviating the use of foreign material is to import tissue from distant donor sites sues collateral to the abdominal wall which in the form of tubed pedicles can gradually be migrated into the defect thus reducing all the hazards of a one stage repair

For an adequate reconstruction of a large upper abdominal void two thoraco abdominal tubed pedicles are advised One of these is formed on each side of the abdomen (Fig 216) These are then waltzed into the near vicinity of the defect and one is used

Fig 216 (*Left*) Extensive abdominal defect due to gunshot wound which resulted in herniation of abdominal contents The latter were covered by split graft which was sutured to the periphery of the defect Results as shown one year after injury with plan of total reconstruction based on collateral abdominal tubes indicated (*Right*) Complete migration of left tube with right tube ready to be transposed into midline parallel with its mate See text for final repair of abdominal defect Pronounced herniation due to gaseous distention of bowel

to the abdominal defect not as a free graft but in the form of pedicled tissue whose circulation is interfered with to a minimum and whose vitality and integrity are therefore maintained to a higher degree Such tissue importations are frequently unavoidable in extensive voids of the upper abdominal wall To avoid extensive dissection of the abdominal wall gross bleeding during the operation overambitious debridement of the defect and the shock of the operation recourse may be had to the tis as a substitute for the endo abdominal fascia after removing its epithelial covering whereas the other may be used as the outer covering of the abdominal wall The former is apposed against the split graft covering the viscera via its skin side The simplest way in which to accomplish this is to cauterize the outer surface of the split graft with standard tincture of iodine or wipe it with full strength carbolic acid either one of which must then be neutralized immediately by alcohol Due to removal of the

epithelium the tubal tissue becomes adherent to the peritoneal substitute (the free skin graft) and because of its fatty content lends thickness to the abdominal wall The second tube after being migrated to the defect is opened and superimposed upon the first fatty layer to fatty layer and the skin is sutured to the abdominal skin itself Coincident with the implantation of the second tube a certain amount of fascial transposition is usually possible which only adds to the strength of the reconstruction Such tubes do not weaken the abdominal wall

Perforating Voids Perforating voids of the abdominal wall resulting in gross evisceration seldom come for reconstruction because of the attendant mortality As a rule such cases are the result of war injuries Where it is possible to conserve the life of a patient the protruding abdominal contents become adherent to the opening and may be covered by a thin split graft pro tem The abdominal wall is then splinted as best possible to prevent immediate eventration and scarring is allowed to take place This converts a perforating into a deep void When the patient becomes ambulatory the case may be handled in the same manner as applies to deep voids of the abdominal wall Only in these cases there being no viable peritoneum to which the de epithelialized and inverted tube can become adherent it is necessary to produce a raw surface on the split graft substituting for the peritoneum by phenol alcohol swab three or four days preoperatively so that the inverted tube may become adherent to it The cauterization of the exposed split skin graft is only necessary where it is not completely covered by granulation tissue This is usually the case in very extensive losses of the parietes The granulation tissue will proceed centripetally to a certain distance for a time and then stop leaving the center of the graft with its epithelial covering exposed The epithelium in these cases should be epilated by chemical cauterization The tubal tissues will then adhere to it thus avoiding a dead space in the region of the repair

Derangements

Derangements of the abdominal parietes are usually segmental and include tissue distortions displacements and misplacements All such aberrations may be subdivided for surgical purposes into superficial and deep derangements

Superficial derangements of the abdominal wall involve the skin and the subcutaneous tissue exclusively and are for the most part made up of scars These should be excised in accordance with the principles laid down in Chapter 18 Surgery of Scars and such special circumstances as apply to the abdominal skin particularly Closures of superficial abdominal derangements are rarely difficult because of the elasticity of the skin and the only caution to be exercised is the avoidance of postoperative surgical deformity which may result from ill advised or poorly planned flaps and suturing When this results it is due to the fact that the flaps mobilized to cover the surgical defect are not created in accordance with established principles of plastic surgery In general if such flaps run horizontally across the abdomen they almost invariably answer not only the needs of repair but the prerequisites of good plastic reconstruction

Deep tissue derangements of the abdominal wall are almost exclusively attended by congenital hernias These are not true voids from the standpoint of reconstruction Although a communication with the abdominal contents may exist there is usually an adequate amount of tissue present which if properly mobilized will suffice to cover the defect It is only after years of trauma to the hernial opening that the tissues become so thinned fibrosed avascular and retracted that a true tissue void exists Originally such hernias are comparable with harelips and other such congenital conditions where adequate tissue is almost in

variably present for a satisfactory reconstruction This only fortifies the well known postulate in surgery that all congenital hernias should be repaired as early in life as possible Delay only means the translation of a congenital tissue derangement into a tissue void and makes the reconstruction of the defect a much more difficult problem

EXCESSES

Tissue excesses of the abdominal parietes may be true or false The true excesses are conditions marked by a superabundance of the tissues normally constituting the abdominal wall The false excesses are those due to the presence of neoplasms hernias abscesses aneurysms etc

These must be accurately differentiated because the methods of reconstruction vary with the contrasting surgical pathology present Where an abdominal excess is due to the presence of a large tumor the excision of the tumor actually creates a tissue void which must be reconstructed according to methods cited under that heading Tissue excesses which are essentially metabolic or congenital are usually marked by a superfluous amount of subcutaneous fat and skin and therefore resolve themselves into operative excisions and closures (lipectomies)

The reconstruction of metabolic or congenital tissue excesses of the abdominal wall fall under the heading of the so called lipectomies

Abdominal Lipectomy An abdominal lipectomy is usually a serious radical procedure because extremely fat patients are not the best of operative risks Their blood pressures may be too high or too low the cardiac muscle and liver suffer from fatty infiltration the kidneys may have a lowered secretory capacity and aeration is often reduced due to relative deformities of the thoracic cage with the additional embarrassment of heavy breasts

Lipectomy should be a preoperatively well planned and thought out procedure The amount of excision of tissue should be marked beforehand with the patient in a standing as well as a reclining position If the superfluous fatty tissue involves only the lower abdomen a transverse abdominal excision is usually satisfactory One precaution is always necessary in doing lipectomies and that is not to traumatize the fatty tissue unduly In fact as has been indicated in a previous chapter it is always good policy to handle fatty tissue with greater caution than is usually accorded other tissues This avoids extensive postoperative fatty liquefaction and necrosis as well as fibrosis which latter only leads to unwelcome formative derangements of the abdominal wall long after operation

After making the skin incision the fat should be separated down to the rectus sheaths by cautious cleavage dissection When the fascial plane is reached as a rule the fat may be stripped back by gauze covered digital dissection to the desired extent After amputation of the outlined block of tissue the most important detail in closure of the wound is never to suture the remaining redundant abdominal fat to the underlying fascia When this error is committed a fibrous adhesion occurs across the abdomen Fat will roll over it in the upright position producing a surgical apron of varying degree

Where the superfluous amount of abdominal fatty tissue involves both the lower and the upper abdomen a vertical or Babcock excision may be done In such instances provisions must be made against the sacrifice of the umbilicus This is particularly important in women for esthetic reasons Where a vertical incision is used in an abdominal lipectomy a V shaped excision on a level with the umbilicus is advisable in the lips of the incision to avoid unusual vertical extent of the incision and puckering of the skin about the umbilical region (Fig 217)

Other precautions as indicated in a previous chapter in excising fatty tissue—this applies particularly to extensive abdomi

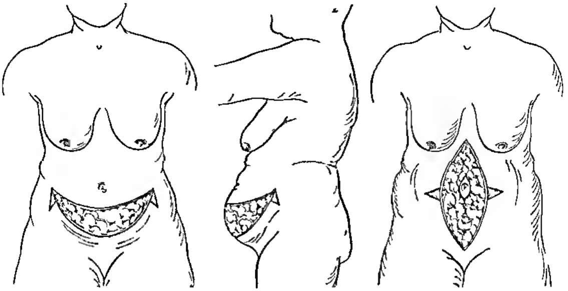

FIG 217 Types of excisions in abdominal lipectomy (*Left* and *center*) Approach in lower or subtotal abdominal lipectomy (*Right*) Secondary approach in total abdominal lipectomy Note conservation of umbilicus In cases not too extreme the two excisions may be combined

nal lipectomies—are complete hemostasis, atraumatic performance and postoperative drainage This drainage may be continued for two or three days after operation to make certain that no late tissue necrosis or hematomas occur After the sutures are re moved from the abdominal skin the patient should wear a supporting binder for a mini mum of two months

VISCEROPLASTIES

Intra abdominal visceroplasties are an ex tensive field hardly explored The principles of plastic surgery apply here as they do elsewhere but because of the special con ditions prevailing in the abdominal cavity, particularly in connection with the physio logic mechanics of the organs and their re lation to one another, this becomes a par ticular field for surgical endeavor Obvi ously abdominal visceroplasties should have one exclusive aim in view and that is function Formative restoration in this con nection is of little or no importance except insofar as form does affect function (See *Chap 23 Esthetic Surgery*")

More and more the specialist in other fields is becoming conscious of the necessity for the application of the principles of plas tic surgery to functional restitution of or gans contained within the body cavities It is hardly within the scope of this volume to treat this extensive field adequately and the student is therefore referred to com prehensive general and special texts on such reconstructive procedures as oesophago plasties nephroplasties, enteroplasties, etc

There are nevertheless certain intra ab dominal conditions which are of daily in terest and consequence to the general surgeon, which do not involve extensive procedures upon any special organs but are rather concerned with conditions extrane ous to these organs and essentially made up of adhesions, intra abdominal scars, ptosis and prolapse To this group may be added certain intra abdominal neoplasms essen tially benign, which may involve the outer coverings of the various intra abdominal organs and whose enucleation or excision always poses the problem of the coverage of the raw surface remaining after excision

Insofar as intra abdominal conditions and the anatomy of the peritoneum permit these raw surfaces are amenable to repair in accordance with the same principles which apply to the closure of superficial defects elsewhere One intra abdominal factor makes this problem even somewhat easier than it is in the repair of extensive cutaneous surfaces, namely, the displaceability of the intestine without noticeable interference with its function This to a limited degree can be used in the coverage of raw surfaces in the abdomen if it does not lead to kinking of the intestine in the various positions which the body is to assume postoperatively An additional aid in the coverage of raw surfaces, particularly in the upper abdomen, is the presence of the omentum It or parts thereof in the form of pedicles or free grafts can be used without interfering with the over all function of the appendage

SCARS (ADHESIONS)

The item of greatest concern to the abdominal surgeon is the problem of existing intra abdominal scars Their simple transection or excision is not, as a rule adequate treatment because it leads to more scarring—the result of more extensive raw surfaces consequent upon the excision of the scar tissue Therefore, the student of plastic surgery should bear in mind that the age old practice of the simple transection or excision of intra abdominal scars is ipso facto a wrong premise for reconstructive intra abdominal surgery Intra abdominal scars and particularly those of any important length, are better conceived of as webs In so doing the student gains a better perspective of the basic surgical procedures applicable to the management of scar tissue within the abdomen Hence, the principles and the practices which apply to the management of webs elsewhere can be applied to a certain extent in the correction of such adhesions

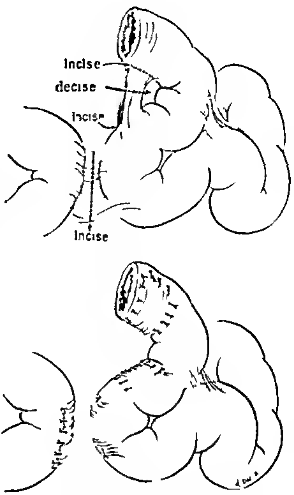

FIG 218 Method of utilizing intra abdominal adhesions for coverage of raw areas by splitting (decision) procedure instead of transection of the adhesions Note that after splitting of the adhesion one leaf remains attached to the upper segment of the intestine the other leaf remains attached to lower segment of intestine As indicated in upper illustration where adhesion is very short and no raw areas need be covered transection with imbrication of raw edges is permissible

Secondly, the intra abdominal scar, as is the case with any scars about viscera is of a different timber and constitution and therefore lends itself better to operative or surgical management than the atrophic or hypertrophic scar so frequently found elsewhere on the body An intra abdominal scar is usually possessed of a smooth surface which lends itself well to the coverage of

raw surfaces in contrast with the scars found in other parts of the body

If, for instance, a flat adhesion is found displacing two organs or two segments of the intestine, its mere excision is not as a rule adequate to good functional results If the scar, on the other hand, is split into two layers, each pedicled on one of the extremes of attachment, the flaps can then be sutured over the raw surfaces of the involved organs with nonirritating suture material, thus avoiding recurrence of scar formation or adhesion to other intra abdominal organs (Fig 218) For further information on the management of intra abdominal scars see Chapter 28, ' Extremities," under the topic, Webs " Many of the principles applied in the management of webs of the extremities are to a degree applicable in the manage ment of intra abdominal scars

Ptosis and Prolapse Although a large number of operations are described for these conditions, few are of basic value This is due to two factors namely, our paucity of knowledge as to the underlying causes for these conditions and the as yet-dominant thinking of the abdominal surgeon that what cannot be excised or drained is not strictly speaking surgical The latter is to a large degree the result of lack of understanding of the principles of plastic surgery by the general surgeon and his lack of acquaintance with reconstructive proce dures

The knowledge of proper management and application of free grafts within the body cavities, or even within organs, the designing and the use of pedicle flaps of available tissue—may lead to avoidance of resective or obliterative major procedures at hands guided by augmented knowledge

A large number of conditions of ptosis or prolapse are basically of congenital back ground, comparable with the inguinal or diaphragmatic hernias The problem in the early stages is one of reconstruction rather than physical therapy, watchful waiting and eventual resection with ablation of normal function The recently observable metamorphosis toward early intrathoracic and intra abdominal plastic reconstruction of anatomic variations in the diaphragm, the mediastinum and the pelvic floor are encouraging witness to the applicability of plastic procedures to many so called "idio pathic" conditions Specific examples of this are Thomas G Orr's and R R Graham's work in the treatment of rectal prolapse, the rapid evolution of oesophago-plasties, nephroplasties, pyeloplasties (see author's ureteromeatoplasty, Chap 36, ' Genitals")

The field of general abdominal reconstructive surgery is a vast and fertile one for research and the application of the prin ciples of plastic surgery

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25

Breasts (Mammaplasty)

Plastic surgical problems in connection with the breasts are manifold They have to do with the revision of contour of malformed breasts following ill advised incisions, scarring or burns, the reduction of the size of the breast, the reposition of breasts, the construction of anatomic substitutes resembling the missing breast and the many problems which arise in connection with breast amputation and its consequences The solution of these problems to a large degree depends upon the anatomy and the physiology peculiar to the human breast Therefore, it is pertinent for the student to be acquainted with certain basic facts in this connection

ANATOMY AND PHYSIOLOGY

The pain fibers of the human breast originate in the fourth and the fifth dorsal spinal segments The blood supply of the breast has a threefold source branches of the mammary artery, the lateral thoracic and the perforating intercostal arteries The first supplies the medial aspect of the breast and the region of the nipple and the areola The lateral thoracic supplies the outer aspect of the breast usually down to and including the portion of the organ on a level with the inferior border of the areola The two sources of blood supply anastomose very freely in and about the region of the areola There is ultimately considerable variation in the quantitative supply from the two sources as well as the degree of anastomosis between the two Both arterial supplies run deep to the gland until they reach the level of the upper border of the areola where they become more superficial Either one or the other source of blood supply may be totally absent This is more commonly true of the lateral thoracic source of supply According to Malniac, the distribution of the main arteries of the breast as well as their relationship in terms of anastomosis and participation in the supply of the nipple and the areola enjoys a certain percentage pattern (Fig 219) The various sources of blood supply and their relation to one another as concerns anastomosis anatomic position and frequency of presence or absence has an important bearing upon mammaplasties

One of the most formidable anatomic factors involved in the problem of breast reconstruction is the question of the supporting structures of the breast The skin covering the breast is probably the least important factor in this connection The element of greatest import in the maintenance of the shape and the position of the breast is the integrity of the glandular tissue itself plus the quality of the fascial interlobular investments which fuse into a fascial envelope with the fascia of the thorax to form the so called suspensory or Cooper s ligament which is attached in the infraclavicular region at the level of the second rib This acts as the main supporting element insofar as the position of the breast is concerned The gland is only loosely attached to the underlying pectoralis major by areolar tissue From this it becomes quite apparent that though the normal anatomic supports are adequate for the virgin breast they are not altogether sufficient for the lactating breast If with the advent of lactation there is coincident

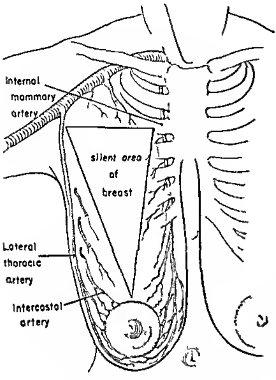


FIG 219 Arterial blood supply in pronounced mammary ptosis Note extensive displacement of vessels to the periphery of breast as well as their relative tortuosity Also observe creation of resultant 'silent area' of breast due to blood vessel displacement

and marked deposition of fatty tissue, which only weakens the integrity of the interlobular fibrous investments, the most important supporting structures of the breast are thus permanently impaired, leading to unavoidable ptosis

Considerable discussion in the literature of the past decade will be found concerning the problem of the nipple in mammaplasties The matter of the transfer of the nipple in reconstructions of the breast is one of the important factors—if not the most important—that determine choice of procedure The entire problem centers about the question as to whether the nipple with its areola must be transposed in the form of a pedicle maintaining a constant blood supply, or whether it can be transferred as a free graft Aside from the technical problems involved the difference of opinion arises out of a difference in concept as to what constitutes the nipple By definition the nipple is the conic organ which gives outlet to the milk, the mammilla, or teat " Max Thorek contends that the physiologic integrity of the nipple as an organ is conservable in free transfer Malimac, of the opposite school, takes the position that on the basis of known principles in plastic surgery it is impossible to retain the functional integrity of the nipple following free transfer If one strives for tissue transfer, insisting upon the maintenance of its functional *integrity with related parts*, it is difficult to see how free transfer of the nipple could maintain its integrity as an outlet for breast secretions unless something were done, parallel with the transfer, to re-establish functional communion of the ducts with the breast tissue This, of course, is mechanically impossible in view of the anatomy of the nipple and the 15 to 18 small ducts converging into it Malimac emphasizes the point as follows "The 'take' of a freely transplanted nipple is technically impossible, as the ducts and muscle fibers will unavoidably slough Freely grafted areolar skin usually 'takes' in the same manner as any other type of skin ' * In this he is supported by Else K LaRoe The sloughing of muscle fibers must be minimal, since erection of the nipple follows 6 to 8 weeks after transplantation

Notwithstanding, M Thorek, in presenting microscopic evidence of glandular regeneration in transplanted nipples quotes Prudente of Buenos Aires who relates an experience with three patients as follows

When the terminal portions of the lactiferous canals are transplanted with the areola, the *cells, having embryologic characteristics, have* power to regenerate the glandular acini, which may be observed as regeneration of the mammary gland tissue, this being more pro-

* Malimac J W Critical analysis of mammectomy and free transplantation of the nipple in mammaplasty Am J Surg (N S) 65 364 367, 1944

nounced in the presence of a pregnancy following the operation

Glandular regeneration which is important even by itself, from the biologic standpoint is even more useful from an esthetic standpoint because the new glandular tissue serves as a support for the areolar mammary region *

It has been the author s experience that the freely transplanted nipple does not atrophy appreciably or slough and that in the course of from 6 to 8 weeks it does respond to mechanical stimulation by erection This would seem to show that complete atrophy and sloughing of the muscle content of the nipple as contended by Malinia is not necessarily true The essential point of Maliniac s thesis that the nipple cannot be free transplanted in the anatomical sense with the hope that it will survive as a composite glandular graft probably holds true

Obviously the foregoing problem needs further investigation and clarification to reconcile the assumption of spontaneous reconstitution of the lactiferous ducts

Most grossly hypertrophied breasts of course are functionally sterile In such cases the difference of opinion apropos the nipple is immaterial The only question is whether or not the free transfer of the mammillary papilla and its areola permits maintenance of its anatomic rather than physiologic integrity Enough evidence has been offered in this connection to warrant its acceptance On the basis of known facts in plastic surgery the maintenance of simple anatomic integrity following free transplantation is as valid here as in the case of skin elsewhere

VOIDS

The absence of breast tissue may be partial or total It may be due to traumatic surgical or congenital causes The methods of reconstruction depend upon size shape and quantitative as well as the qualitative integrity of the tissue present In partial voids the choice of procedure may depend upon age and marital status of the patient In older women particularly where no further childbearing is anticipated it may be more intelligent in selected cases to reduce the unaffected breast to conform with its smaller mate which has sustained the loss This implies a less time consuming procedure a one stage operation and avoids the economic and tissue cost of reconstruction In young girls and young women such a procedure is contraindicated because the good appendage must be conserved for reasons of breast feeding

Total

Where total absence of one breast exists and the general health of the patient or the integrity of the donor tissue is not equal to the surgical task the appendage may be substituted by an inanimate prosthesis But where construction of a total breast is feasible a very adequate physical representation of a normal appendage can be produced Where a total reconstruction of a breast is undertaken it implies the importation of an amount of skin and subcutaneous tissue over the affected pectoral area consistent with adequate formative mimicry of the normal breast present This is usually best accomplished through the use of a tubed pedicle For the average breast in a young woman the method of Gillies consisting of a thoraco-abdominal tube whose abdominal extremity ends in an island of tissue is usually adequate (Fig 220) but in older women or those having one rather prominent breast this does not always supply an adequate amount of tissue This can be circumvented by augmenting the extent of the thoraco abdominal tube to a degree permitting a W type of deposition of the tube over the pectoral region (Fig 221) After proper allocation of the tube on the chest, various segments of it are de epithelialized and incised in such a way

* Thorek M Plastic reconstruction of the breast and free transplantation of the nipple (author s one stage operation) J Internat Coll Surgeons 9 1946

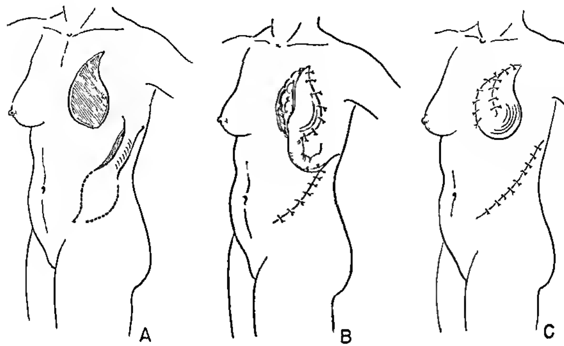


FIG 220 Gillies' method of total mammaplasty

that they can be gathered up into a prominent mass of tissue resembling the more or less normal breast Following healing and organization of this mass of tissue, some form of mimicry of the nipple must be produced There are several methods for its imitation One is by simple tattooing of an appropriate circular area, another consists in the rotation of a small flap so as to form a deliberate nippling or fold in a predetermined position and several other methods which are based upon the centripetal gathering or heaping up of tissue at the point where a nipple seems desirable in comparison with the normal breast This is followed by tattooing of the newly created nipple (Technic same as for tattooing grafts)

Partial

Partial voids of one breast are corrected by equalizing the contralateral breast The affected breast should first be reconstructed so as to give it the best possible form After the lapse of from 3 to 6 months when this has organized into permanent shape, the unaffected breast may be reduced to make both appendages symmetrical The basic approach to the accomplishment of the latter resides in the surgical removal of a segment or section of the good breast comparable to the part lost or ablated in the affected breast This guarantees not only similar size but like symmetry of both breasts

DERANGEMENTS

Derangements of the breast—be they distortions, displacements or misplacements—are almost always segmental and may be divided into those affecting the nipple, the areola and the breast proper According to Dickinson, a nipple may be inverted, hollowed, mulberry, fissured, stunted, cone shaped or mushroomed Unless these faulty developments are extreme or affect the functional potency of the nipple, nothing should be done about them Where the condition is extreme and careful and calculated tissue excisions can improve the appearance of the nipple without interfering with its

functional integrity, such procedures may be entertained.

Areolar derangements are usually of one of two types: either too much or too little of areolar tissue is present. A patient will rarely complain of a small areola, but not infrequently will seek correction of an unusually extensive areola This can be done

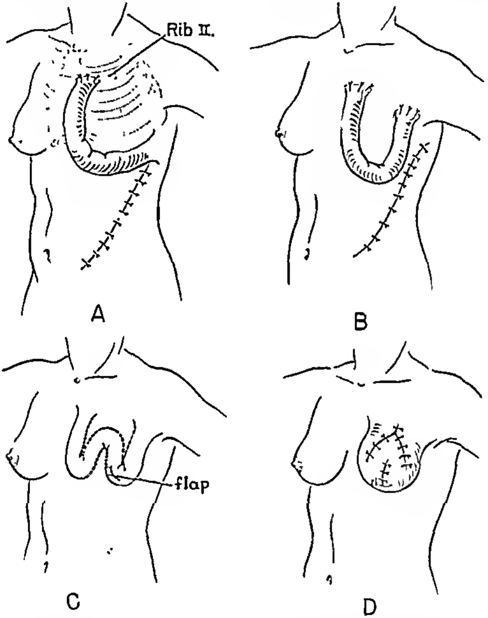


FIG. 221. Pick's method for total mammaplasty. This consists of (A) making an extensive thoraco-abdominal tube which is then migrated into position (B) This avoids anxiety over integrity of island tissue in Gillies' method and also the difficulty of closure of the donor site from which the island has been taken. (C) Medial elevation of loop of tube graft to a position somewhat lower than transposed peduncles of tube. Broken lines indicate partial decortication of tube with removal of most, but not all, of the derma The raw areas thus created are sutured into apposition (D) to mimic as closely as possible the shape of the normal breast After the lapse of 2 or 3 months, a nipple may be constructed in situ.

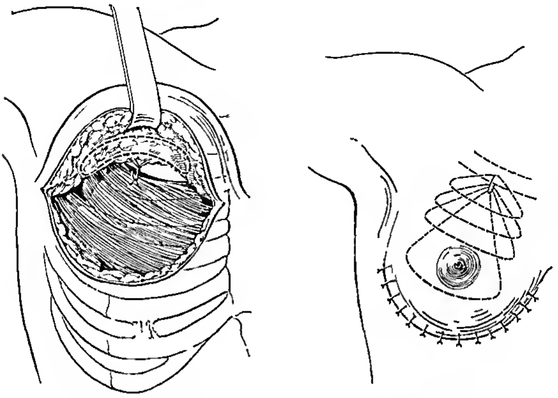


FIG 222 Girard's mammapexy, illustrating hammock suturing of breast to thoracic wall (only indicated in breasts needing repositioning)

comparatively easily by careful circumferential excision of the desired amount of the periphery of the areola Such an excision should begin within the plane of the areola and progress outward Only a shallow epithelial incision should be made about the nipple and the epithelium undermined to the existing periphery of the areola At that point the dissection should be directed into the subcutaneous fatty tissue just beneath the derma and carried on circumferentially for a distance consistent with the advancing of the nonpigmented skin to the point of the original epithelial incision This is done after excision of the dissected areolar tissue

Another method consists in the excision of radiating triangular wedges apices pointing nippleward, from the areola and then closing the surgical defects by undermining closure of the triangles according to one of the methods illustrated in Chapter 21, 'Surgical Geometrics"

Scars The most important derangements of the breast proper are scars, the result of ill advised incisions, severe burns, or such derangements as result from inexpert mammaplasties

The last constitute breast deformities of varying and variable degrees associated with considerable fatty necrosis, scarring and malposition of the nipple Their correction is usually a major procedure involving a high degree of consideration for symmetry and much experience in the designing of appropriate incisions, flaps and the management of soft tissues

In the excision of scars involving the breast, the student is cautioned to remember that in the closure of the surgical defect consequent upon scar excision, the suture lines must be overcorrected If this is not

done the scar will have a tendency to invert or later to sink into the softness of the breast thus leaving a depression in the course of the suture line which may be as unsightly as the original scar Breast scars are usually quite deep and involve considerable of the thickness of the subcutaneous fat In these conditions scar decapitation (Fig 167) is advisable thus avoiding to a large degree the possibility of tissue inversion or retraction postoperatively

One of the most common conditions of breast derangement is the so-called ptosis Although this is usually found in connection with hyperplastic or hypertrophied breasts it is frequently associated with otherwise normal sized breasts In the latter condition it is as a rule a moderate degree of ptosis which for one or another reason the patient feels is inimical to her welfare and happiness

The repositioning of such breasts can be accomplished through a submammary incision without the need for transposition or transplantation of the nipple The line of cleavage between the breast and the thoracic wall is allocated and the entire gland may then be freed by dull dissection or peeling from the chest wall with a gauze covered hand In elevating the breast from the thoracic cage all reasonable effort should be made to conserve whatever large perforating arteries are encountered not only to conserve the circulatory integrity of the organ but also to minimize the possibility of postoperative submammary hematoma When this has been accomplished and the breast en masse is held in its desired position by the assistant it is sutured in its elevated position with heavy silk cotton or kangaroo gut to the thoracic wall The incision is closed in linear manner and the breast is splinted into position by elastic bandage for a period of two weeks after which the patient is required to wear a specially designed brassiere both day and night for a period of another month (Fig 222)

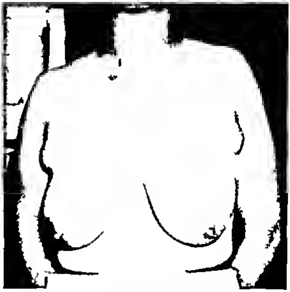


Fig 223 A case of bilateral multiple breast in a woman 38 years of age Note absence of nipple on aberrant glands The latter were enlarged and painful during menstrual period Simple enucleation remedied the condition

EXCESSES

True

Tissue excesses in connection with breasts may be due to tumors multiple breasts or the so called virginal hypertrophies and hyperplastic conditions

Multiple breasts though comparatively rare do occur and involve the complete eradication of the aberrant breast tissue (Fig 223) Multiple breasts may be found anywhere between the anterior axillary fold and the groin in the so-called milk line There may be one or more pairs of aberrant breasts In any case their simple but complete excision resolves the patient's complaint Such aberrant breasts may or may not have a nipple and may or may not be functional

The adequate reconstruction of the hypertrophied hyperplastic or prominent pendulous breast is a major surgical procedure which needs considerable experience and mature judgment in its undertaking The magnitude of the problem and the diffi

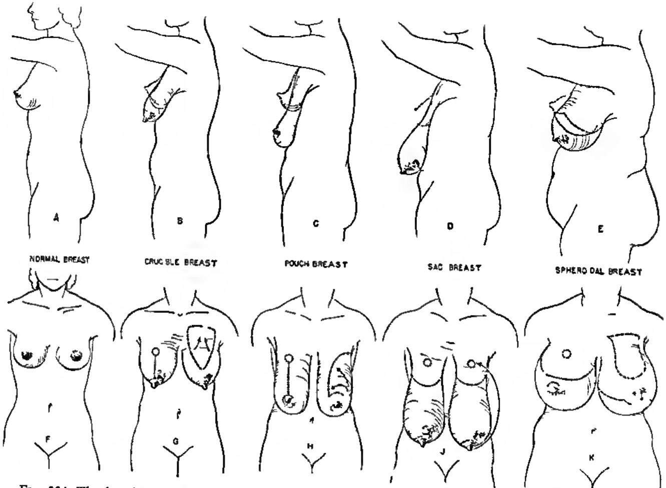


Fig 224 The four basic types of pendulous breasts B E, pre and postoperative profiles of breasts G K, the broken lines over right breast indicate type and extent of skin incision for mammaplasties most appropriate Broken lines over left breast indicate type and amount of excision of deep tissues in attaining reduction of size Arrows in G and H indicate direction of transposition of remaining breast tissue Arrow in J indicates free transfer of nipple and areola following partial amputation of breast, the only feasible procedure for such extreme ptosis

culties associated therewith can best be illustrated by the fact that 31 separate methods exist for the ablation of this condition This does not include a legion of modifications devised by various contemporary writers Most of the methods extant in the literature have their practical application but the greatest difficulty arises out of attempts to apply some one method to all types of breast enlargements no matter what their direction or extent Although it is true that certain of the methods described in the literature of the past as well as the present are applicable in greater degree than others none of them do or can solve the problem of reconstruction of all types of hypertrophied or pendulous breasts With experience it soon becomes evident that in dealing with the reconstruction of any soft tissue and particularly of the pendulous type no one method can claim exclusive priority over all others This could be possible only if living tissue were subject to Hook s law of elasticity and permanent set as brought out in Chapter 21 Surgical Geometrics The variability in the dimensional extent and anatomic peculiarities of breasts is so prominent that whatever the method it must at all times fit the case in hand In other words the prevalent tendency and fallacy of trying to fit all breasts to a method is one of the major factors responsible for the confusion which still exists in the presentation of this subject to the student It is far better for the latter to be permanently impressed with the unchangeable truth that the reconstruction of soft tissues will submit only to principle but seldom to rigid procedure Strict adherence to procedure in soft tissue reconstruction will lead only to monotony of esthetic result and may eventuate in functional aberration

The satisfactory formative reconstruction of the breast is a complex procedural problem as well as a physiologic challenge ever varying and variable even at the time of operation It necessitates a sense of proportion an appreciation of symmetry and geometric perspective not easily attainable except by constant practice much experience and accuracy of technic A true geometric evaluation of breast excesses with a parallel surgical perspective would be of inestimable value in the delineation of appropriate procedures for given problems To this end Aufricht has recently devised a geometric approach to the problem His method is illustrated in Figure 230 He conceives of the breast as a three dimensional hemisphere whose true center is the nipple but whose surgical center is 2½ to 3 cm above this By estimating a basic geometric silhouette translatable into a triangle within a parallelogram he is able with a minor modification to apply the dimensions of the geometric patterns to the establishment of a new breast size and form It is a commendable attempt at the application of geometrics to the surgery of reconstruction If the method is understood and applied with the necessary flexibility dictated by individual needs it will avoid one of the dangers of rigid calculations apropos the variability of esthetic needs It does not intend a virginal silhouette

As indicated heretofore certain of the many methods extant seem of easier and more satisfying application than others Among these are the procedure of Girard DeQuervain Lexer Kraske Passot Axhausen and Biesenberger The difference between any two of these methods is basic This is determined by their stress upon one of three principles underlying mammaplasties These are overall repositioning of the tissue mass resecting of the tissue mass or revision of the skin brassiere (Aufricht) supporting the breast The Poussant and Lexer Kraske methods are based on resection and reformation of breast mass The Biesenberger procedure is based on resection and reconstruction The Passot procedure is based on revision of the skin brassiere with repositioning of breast mass Others are combinations of the various

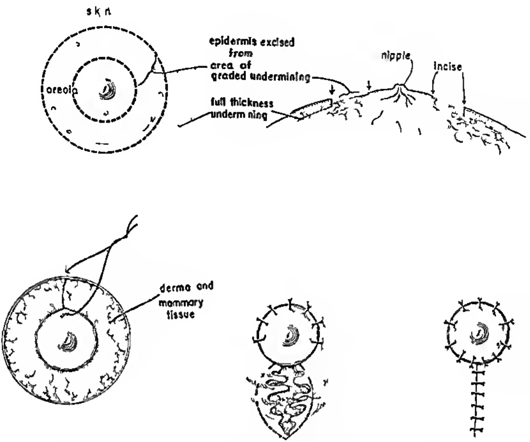


FIG 225 Transareolar approach in mammaplasty The outer circular area (at *top left* and *bottom left* the area of epidermal undermining) begins with epidermal incision and ending in full thickness undermining at periphery of areola is imperative to avoid injury to ducts and to preserve circulation of nipple

principles Most contemporary procedures including the authors are only amalgamations or modifications of one or another of the preceding methods

The author's method as illustrated in Figure 231 has been particularly serviceable in preserving the physiologic integrity of the breast In a group of 11 young women who were married subsequent to the operation 4 have thus far been able to nurse children bilaterally One patient has been able to nurse on only one breast (the left) she developed a large postoperative hematoma in the right breast with some late fatty seepage This may account for the unilateral functional result

To apply intelligently the various methods available to the student he should first of all keep in mind a certain elemental geometric variation in hypertrophied and pendulous breasts These may be divided into the crucible shaped breast the pouch shaped the sac shaped and the spheroid type (Fig 224) This rather general classification of breast forms allows for some practical visualization of what is necessary in terms of excision tissue shifting and rotation in order to accomplish more or less normal replacement of the tissue mass remaining If this geometric visualization of the over all outline of the breast can be seen in three dimensional perspective and if

the same approach in terms of evaluation is applied to the various procedures available, a better correlation of type of breast and method will result Obviously, this is possible only to the extent that the anatomy of the pendulous or hypertrophied breasts will permit, but without a geometric perspective and correlation of method, procedure becomes surgical promiscuity

Methods of Reconstruction

From the standpoint of reconstruction all hypertrophied pendulous breasts have three things in common first, the tissue mass has to be reduced, second, the resulting breast mass must be repositioned to near normal breast location and third the original breast envelope must be revised to give an appropriate skin brassière The reduction of mass is dependent upon three factors (1) size of breast, (2) distribution and nature of mass and (3) circulation Elevation of the pedicle remaining after reduction depends upon its geometric form

Transareolar Approach All recognized standard physiologic mammaplasties begin with or eventually involve the transareolar approach to the underlying glandular tissue This consists of the making of an incision into the epidermis of the areola at a predetermined point whose circumference denotes the future areola This is then followed by centrifugal elevation of the epidermis As this dissection progresses it is beveled into and finally through the derma so that when the scalpel reaches the periphery of the original unreduced areola, it has reached the depth of the subcutaneous tissue as illustrated in Figure 225

The dissection is then continued subcutaneously throughout the extent of the breast, care being exercised to leave a layer

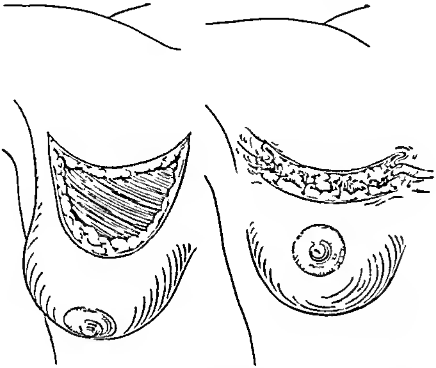


Fig 226 The Pousson mammaplasty This is based on adequate excision of 'silent area' of breast with indicated transposition of remaining breast tissue Because it leaves a scar on the breast it is esthetically undesirable but historically important for its earliest emphasis of the 'silent area'

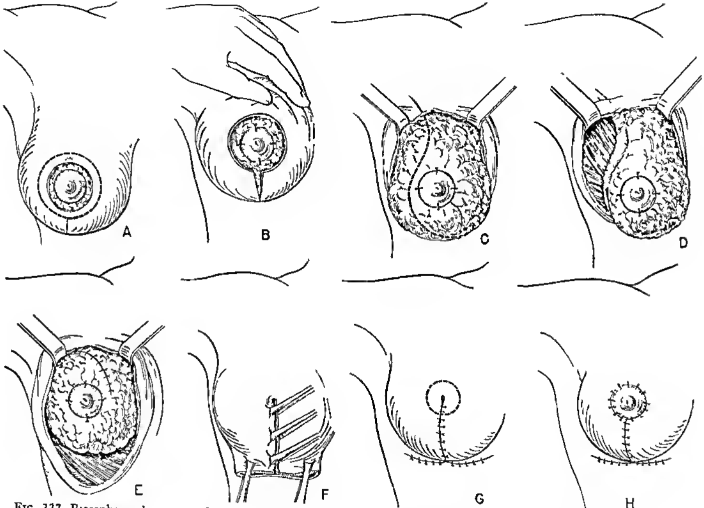


FIG. 227 Biesenberger's mammaplasty. This is based upon adequate excision of lateral and inferior one third of the breast after proper skin dissection (cf **Fig 224H**) (Indicated in pouch type of breast)

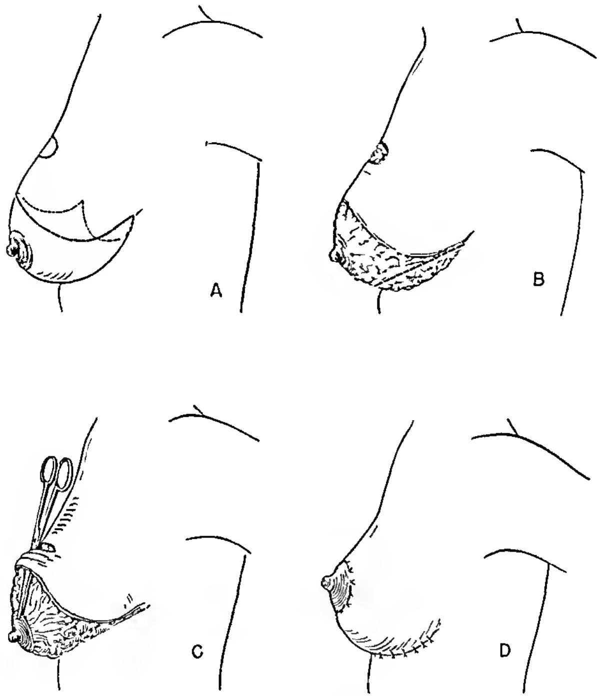


FIG 228 The Passot mammaplasty (Indicated in moderate crucible type of breast)

of fat on the underside of the skin envelope This preserves the integrity of the cutaneous circulation

When the resection of the breast tissue has been completed and the defect closed, the excluded area of the areola still attached to the skin of the breast, is amputated, and the skin proper is brought in apposition to the reduced areola remaining about the nipple as illustrated The augmented circumference of the skin apposed to the new areola, when reduced to the

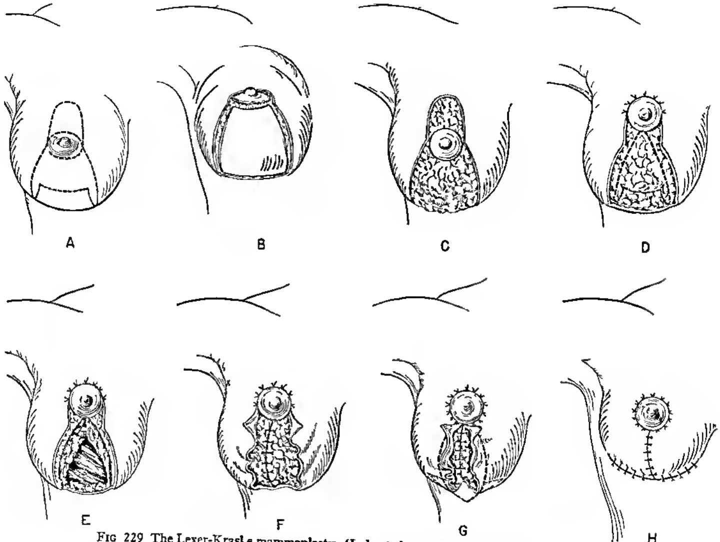


FIG 229 The Lexer-Kraske mammaplasty. (Indicated in spheroidal type of breast)

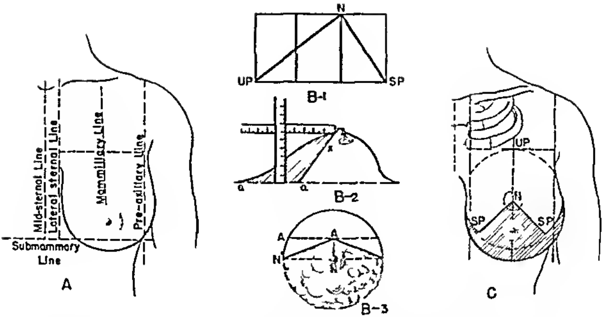


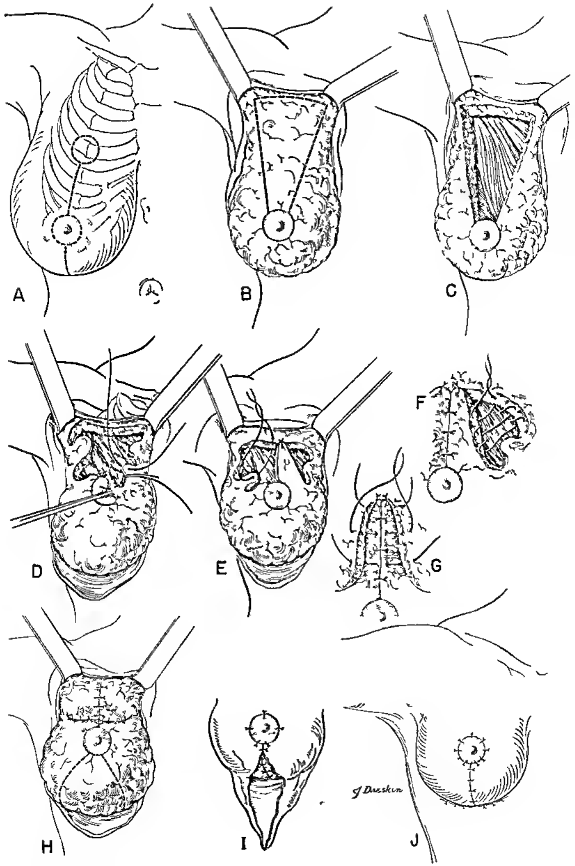
FIG 230 Aufricht's mammaplasty (A) Lines used in geometric planning of mammaplasty Horizontal broken line is the diameter of the breast Midsternal line runs from jugular notch to submammary line Lateral sternal line runs along insertion of costal cartilages Pre-axillary line corresponds with anterior limit of the fold Mammillary line is determined by bisecting width of breast at point 1 to 1½ above location for new nipple and connecting this point with the real nipple Submammary line is determined by level of submammary crease All lines are determined with patient in erect position except the submammary line

(B 1) The quadrangular pattern The long side represents the diameter of breast the short side the thickness of the breast The quadrangle is divided (arbitrarily) into three equal parts A diagonal is drawn into the first two units of the quadrangle the segment UP N which represents the distance from the third rib to the new nipple site The second segment the diagonal N SP *represents the new inframammillary profile* Together the two diagonals comprise the silhouette of the new breast

(B 2) Manner of measuring thickness of breast with patient in horizontal position also location and amount of resection (x a a) of upper pole of breast The vertical ruler rests on chest while the horizontal ruler forms a tangent to the summit of the breast Shaded area a a x denotes resection of upper pole of breast Point x in the course of the operation is sutured to point a thus resulting in the calculated elevation of the new breast Line x a represents one side of resected breast tissue This is sutured to its mate on the other side to complete modeling of the breast substance

(B 3) Discrepancy between geometric planning and actual surgical excision possible This difference represented by triangles A N N is due to the fact that the original measurement taken and the resection formulated are calculated on the principle that all diameters and radii pass through center of the breast hemisphere at N Such excision is not actually possible because of the necessity for preserving circulation of the nipple and areola Hence the shifting of centers of excision above the real center to A A N N and A A N represent projection of triangle of excessive tissue on periphery usually amounting to about 3 cm One half of this is compensated for by removing an additional 1½ cm from breast periphery The other half is compensated for by making the circumference of the planned skin brassiere 1½ cm longer

(C) Planning of the skin brassière (see B 1) Unshaded area between UP SP N SP constitutes flap for the skin brassiere whereas the shaded area represents extent of excisable skin (This is accomplished with aid of special metal tape See original article) UP is level of lower border of third rib N is site of new nipple N SP is distance from new nipple site to future submammary line Unshaded area represents skin to be employed for new brassiere Shaded area is extent of skin excised after breast resection is completed (Redrawn from Aufricht Mammaplasty for pendulous breasts empiric and geometric planning J Plast & Reconstruct Surg 4 13 29)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latter condition results in an excessive amount of skin inferiorly This is excised as illustrated in Figures 227, 229 230 and 231

The crucible type is the least common of the four types of breasts marked by tissue excess It is essentially wide across its superior pole with a relatively narrowed inferior pole The tissue excess which marks this type of breast is due to a superabundance of fat in the upper part of the appendage Since there is no coincident or parallel hypertrophy of the glandular tissue (there may even be an atrophy) the inferior pole of such a breast is a relatively narrow or even pointed one

The procedures suitable to the reconstruction of this type of breast are those which permit of the removal of the excess fat in its superior pole and so a reduction of its size (methods of Dehner Pousson Schreiber and Aufricht) Elevation of this type is a secondary consideration When the surgical defect consequent upon removal of the excess fat in the upper portion of the breast has been properly obliterated as indicated in Figure 224 G and 226 elevation becomes more or less synchronous with it In this procedure it is important to accomplish almost geometric reduction of the defect on the two sides by the suturing of the mid points of the descending arms of the surgical defect to the midpoint of the horizontal lip so as to get the maximum elevation of the breast These basic two or three sutures usually of heavy silk fascia or stainless steel wire should at one and the same time be passed through the tissues of the thoracic wall in order to maintain the breast Absorbable sutures are inadequate to maintain breast position permanently

The inverted triangular area above the areola indicated in Figure 231 may be referred to as the silent area of the breast In this particular area one avoids incursion upon the mammary or long thoracic supply of the breast tissue only occasionally meets with the perforating intercostal arterial supply and only to a minimal degree interferes with lymphatic drainage Many contemporary methods (ostensibly proposed as original) are based upon the excision of this silent area in the breast which long ago was known to and incorporated in the method of Pousson Dehner and others The extent of the silent area may vary in the two breasts

The pouch type of breast is the long sausage shaped flattened appendage which may extend below the costal margin and oc

FIG 231 Pick s mammaplasty (A) Skin incisions for opening of breast envelope reduction of areola and new site for nipple The course of the vertical incision is determined with the patient in the erect position (B) Locat on of silent area of breast which can be completely excised without fear of interference with circulation Actually the area is much larger than shown here because of the diff culty of three dimensional representation (C) Complete excision of the silent area of the breast down to the underlying musculature (D) Elevation of nipple area to new site and anchorage of the breast tissue to the underlying musculature and rib periosteum The redundancy of the edge of the silent area is taken up by suturing the medial and lateral lips of the defect to the tissues in the vicinity of the second rib (E) This results in a secondary defect in the average breast in the extreme upper corners of the original silent area (F) This is closed (G) Method of handl ng extreme redundancies of tissue only found in unusually elongated breasts (H) Final reconstruction of superior pole with breasts of unusual length The superimposition of the redundant tissue as illustrated serves as add tional anchorage for the new breast as well as to give greater mass to upper portion of breast a feature lacking in other procedures with the lapse of time and effect of gravity on the new breast The broken lines below areola indicate area of resection of inferior pole to further reduce mass of breast and improve form of the new appendage (I) The skin envelope has been sutured to areola and redundant excess of skin as outlined for excision to complete the skin brassière (J) Completed operation (see Fig 235)

casionally reaches the extreme ptosis of the hard and heavy sac type of breast It is an appendage essentially the result of the complete loss of all supporting investments including the skin the intrinsic fascial investments and the fascial supports This breast is long and narrow with little or no increase

In the use of any rotational maneuver of the breast tissue care must be exercised not to strangulate the circulation to the glandular elements the areola and the nipple

For this reason the author has combined the basic virtues of certain old procedures and augmented the supportive feature of

FIG 232 Clinical examples of hypertrophied breasts (*Left*) Example of advanced pouch type of hypertrophied breast in woman 32 years of age Patient had had two children Always had large breasts which failed to involute after second pregnancy and became heavy Since then she has had constant headaches shoulder pains difficulty in inspiration tired easily and wearing of clothes was an annoyance The breasts became painful late in the afternoon following routine daily exertion (*Right*) Seven years postoperative The Claoue modification of Biesenberger s procedure was employed Both breasts were completed in one stage

in its fatty content and moderate hypertrophy of its glandular elements

There is therefore little need for reduction of mass but pertinent necessity of elevation and repositioning Since a good form of result cannot be obtained by simple advancing of the inferior pole of the breast upward some form of rotational repositioning is indicated This may be obtained by the Biesenberger method (Fig 227) or Claoue s modification thereof

the tissues of the superior pole to better secure the breast in its new position and to enhance the formative results (Fig 231 E H) Both the pouch and sac type of breast have a peculiarity in common not always taken into account by surgeons whereas the upper pole of the pendulous breast is often stretched to exceeding thinness little is done to restore the normal contour of this part of the breast except what inadvertently results from the shifting of the resected

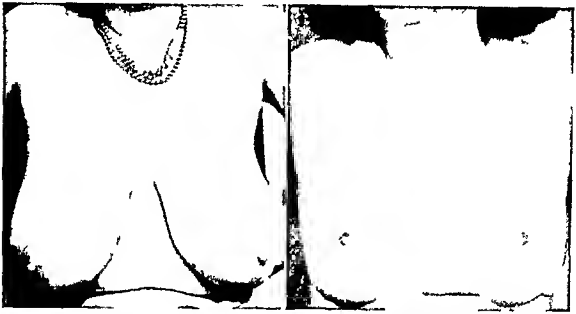

FIG 233 Clinical examples of hypertrophied breasts (*Continued*) (*Left*) Marked pouched type of breast in young woman of 20 Note tendency toward generalized skin ptosis of neck arms and chest The patient was markedly stoop shouldered and had persistent aches and pains in the back of neck and shoulder girdle so that she could not continue with her work in the capacity of stenographer (*Right*) Ten years postoperative A modified Biesenberger procedure was used Although breasts have descended 2 inches in ten years patient has had none of the subjective complaints which she had preoperatively

breast tissue upward In the majority of cases the infraclavicular fullness of breast thus accomplished is only temporary With the passage of time and the influence of gravity the superior pole of the breast is sooner or later thinned out again This can be avoided to a large degree by overcorrection of the reconstructed superior pole In the pouch and sac type of breast all the conditions are present for easy accomplishment of overcorrection After the silent area has been excised and the breast elevated to its new position a redundancy of tissue results laterally and medially which if superimposed over the area of new thoracomammary apposition will supply this overcorrection as shown in Figure 231 An additional salutary feature of this detail resides in the fact that it augments the new supporting force of the reconstructed breast Whereas in other procedures support for the new breast is twofold (suturing of breast to chest and construction of new skin brassiere) in the author s method the support is threefold

The sac type of breast is the most commonly encountered It is almost always a full type of breast wide but flat in its superior extent and wider in its inferior pole particularly in hypertrophies of long standing It is basically a breast with a superfluous amount of glandular tissue which almost invariably is hard fibrosed heavy and impotent (Fig 224 D and J) There is concomitant superfluity of areola with a wide flat massive nipple usually situated at the extreme inferior pole of the appendage The extreme ptosis of this type of breast sometimes reaching the groin or beyond is essentially due to the hardness and the extreme weight of the hypertrophied and fibrosed glandular tissue The size and the degree of ptosis may be such as to preclude any form of reconstructive procedure In such instances subtotal amputation with free transplantation of

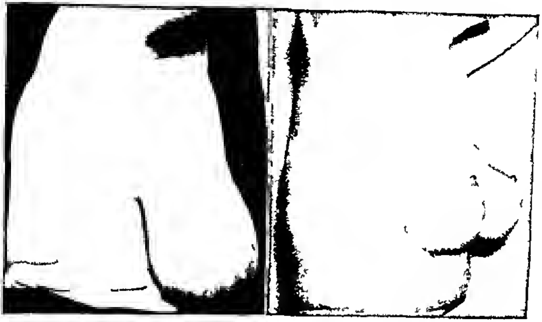

FIG 234 Clinical examples of hypertrophied breasts (*Continued*) (*Left*) Sac type of hypertrophied breast in young woman of 27 Note hard heavy appearance of lowermost extremity of appendage with thinning and narrowing of breast in its upper quadrants (*Right*) Three years postoperative Scar on lateral side of right breast the result of secondary excision of skin fold which developed one year following original mammaplasty There has been no measurable postoperative descensus of the breast in this case (Position of nipples as per patient s wishes)

the nipple may be the only logical treat ment not unlike the management of a breast involved by a benign neoplasm

Where the condition is not too extreme and particularly in women still in the child bearing period the basic methods for this type are the Passot (Fig 228) the Lexer Kraske procedures (Fig 229) Aufricht s procedure (Fig 230) or the second method of Malniac As will be seen from a study of these methods they embody both the ele ment of major resection as well as the re construction of the remaining breast sub stance The choice of method should depend entirely upon the relationship of breast mass to ptosis and geometric configuration The Passot method is essentially applicable to the breast primarily ptosed whereas the Lexer Kraske or Malniac procedures are particularly adapted to the breast which is both markedly ptosed and prominent be cause of tissue mass One of the advantages of the Malniac procedure is that in an ex tremely large breast the method may be divided into two stages the first of which provides essentially for elevation of the ap pendage whereas the second allows for ade quate excision of mass Although other methods like that of Biesenberger may be used and are particularly tempting in the young unmarried woman in the hope of conservation of parenchyma they result in a still too weighty breast with a prominent inferior convexity (Figs 232 234)

The spheroidal type of breast is the very large relatively soft massive and high breast usually found in women afflicted with excessive adiposity or metabolic disturb ance (Fig 224 E and K) The nipple and the areola are usually only moderately dilated and in relatively good position In contrast with the sac type the large spher oidal type needs reduction in tissue mass and only secondarily involves the problem

FIG 235 Clinical examples of hypertrophied breasts (*Continued*) (*Left*) The heavy sac type of breast Patient complained of constant pains in the chest and shoulders with tiring after moderate exertion Preoperative profile view (*Right*) Postoperative profile view one year after operation

of elevation But the problem of reduction of mass in this type of breast is a comparatively difficult one due to a generalized overabundance of fatty tissue necessitating partial amputation in several quadrants of the breast This not only involves removal of much glandular tissue but also the always present danger of interfering with one of the major circulatory supplies of the appendage This type of breast always should be reduced in two or more stages A two stage reduction is usually adequate

The first stage should consist of the reduction or exclusion of the silent area of the breast thus narrowing the superior pole as well as allowing for adequate elevation of the remaining breast substance This results in a deliberate sac type of breast which then can be reduced to the desired size by simple or multiple wedge resection of the inferior pole of the appendage as done by Joseph and Schreiber and popularized by Malniac in his second method

PLAN OF OPERATIVE TIMING

The question often arises as to whether one should do a breast at a time both breasts at one time or a bilateral two stage procedure To a large extent this depends upon three things (1) the experience and the expertness of the surgeon (2) the general condition of the patient and (3) the size and the type of breast with which one is dealing In general the moderately enlarged and somewhat ptosed breasts may be adequately reconstructed in one surgical inn

ing, but, as a rule, in the woman who is in general not an excellent risk and is obviously suffering physically from markedly hypertrophied and ptosed breasts, it is far wiser and usually more satisfactory to do a two stage operation At this point the question arises as to whether one should complete a breast at a time or do a partial reconstruction on both breasts at one time It seems to be rather generally agreed that a partial reduction with elevation of both breasts at the first sitting, with final reconstruction at a subsequent sitting is the more intelligent and safer procedure This, of course, is a generality subject to modification by the three factors enumerated above

The foregoing discussions deal entirely with breast procedures based upon the transposition of the nipple Where the method of transplantation that is, free transfer of the nipple, is used, the total operation may very well be completed on both breasts in one surgical inning The basic concept behind the latter method is not one of actual reconstruction, but rather reduction by amputation On the European continent this method was fathered by Dartiques, and in this country advocated by Thorek It is a much more simple procedure than any of the reconstructive methods described above based on transposition of the nipple, but it has the irreconcilable disadvantage that it is an obviously sterilizing and aphysiologic procedure On the other hand, in breasts which are known to be sterile at the time of operation or of such unusual size that amputation is unavoidable, the chance conservation of the nipple by free transplantation is naturally a more appropriate surgical procedure than the construction of a tattooed substitute

False

Tissue excess due to the presence of a tumor is usually unilateral and therefore should not present any difficulty in diagnosis Manifestly in such instances the important thing is to make the proper differential diagnosis of the nature of the neoplasm

Obviously in the excision of tumors of the breast, the most important concern is that for the nature of the neoplasm In any case, the problem of incisional approach and closure of the surgical defect exists Insufficient attention on the part of surgeons is as yet given to this detail, as evidenced by the large number of patients unhappy about the postoperative scars and deformities resulting from unplanned incisions, excisions and closures

Whenever a section of a breast is removed with a benign growth, one must bear in mind the fact that the breast is a rather definite three dimensional hemisphere All excisions must therefore subserve the geometric rules governing adequate reconstruction of such an appendage This necessitates accurate measurements (See Chapter 21 'Surgical Geometrics' and "Aufricht's Mammaplasty in this chapter)

The closure of the usually extensive surgical void left after a radical mammectomy need not present the difficulties often encountered by the general surgeon if he acquires a certain basic knowledge of the principles of plastic surgery To this end, it has been the tendency recently to use split skin grafts in the closure of such wounds This is very frequently too simple, unnecessary and inadequate a solution of the problem, particularly to the patient It results in "freezing" of the graft to the chest wall and postoperative discomfort to the patient A less time consuming, functionally more appropriate and anatomically more correct closure may be attained by the application of the author's principle of "pleating and circle closure (see Chap 21, 'Surgical Geometrics") In general, if the lateral lip of the surgical defect is undermined over the chest, with the axillary skin already loosened as a result of the extirpation of the lymph glands, a large loose flap is thus created, extending from the axilla well down on the chest Another

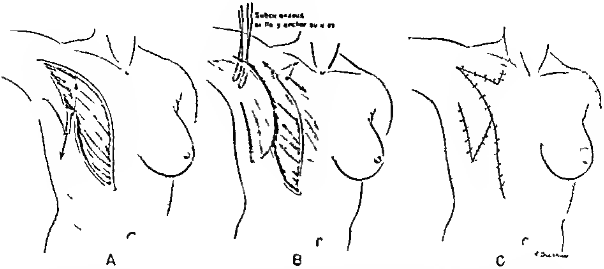

FIG 236 A method of closing surgical void after radical mammectomy (A) Pleating of lateral lip Arrows indicate direction and pull of hooks Broken line indicates incision resulting in flaps shown in B (B) Superimposition of upper flap over lower Broken line indicates secondary incision to form flap to be shifted medially (C) Closure possible without tension Minor pleating and transposition in infraclavicular region only rarely necessary

loose flap already exists in the pectoral region consisting of the skin of the medial surgical lip in the anterior axillary fold If the former is now pleated and treated according to the principle of the circle closure, a triangular flap of the posterior lip may then be shifted medially onto the chest The wedge shaped defect thus created in the lateral lip in the midaxillary line then receives the upper triangular flap of the lateral lip The surgical defect is thus closed without tension or the need of a free graft (Fig 236)

Occasionally the rotation of the upper (axillary) flap of the lateral lip increases the width of the surgical defect somewhat in the anterior axillary region This may be closed by repeating the same procedure to a lesser extent on the anterior lip of the defect in the infraclavicular region

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26

Cheeks (Meloplasty)

The cheek is set aside for special considerations because of its unique response to major injury, its frequently unexpected behavior following surgery, and its vital relationship to the formative and functional integrity of collateral appendages like the eyelids, alae and mouth. It is one of the most frequently injured parts of the anatomy. Its plain and apparently simple formative appearance belies its anatomic complexity and the surgical pitfalls in its repair or reconstruction. It therefore remains a great temptation for elementary and often careless repair. It is a tempting donor site and source of material for reconstructions about the mouth, nose and lower lids. In spite of its innocent appearance the cheek has a very vital function and formative relationship to the face as a whole. It is a kind of anatomic drumhead or hub influencing to a large degree the appearance, position and integrity of many surrounding appendages. Even more, a poorly repaired cheek may also interfere with mastication to a vital degree. Its important relationship to collateral structures is ultimately dependent upon its intricate and important anatomic contents.

The cheek is the stage for distribution and ramification of the most important structures entering into the functional integrity of the face as a unit. The main nerve and blood supply as well as many of the important muscles controlling the function and appearance of the lower lids, mouth, lips and nose all pass through the cheek. It is for these reasons that repair or reconstructions of the cheek command special interest.

There is no more difficult problem of reconstruction anywhere on the face than a bungled or carelessly repaired laceration of the cheek. It is a notorious site for complicated deformities following suture of an apparently simple laceration.

VOIDS

Total

These are, from the standpoint of reconstruction, managed like perforating void (vide infra).

Partial

Tissue voids of the cheek may be divided in the same manner as abdominal voids: superficial, deep and perforating (Fig. 237). All cheek injuries, no matter what their type, have certain tendencies in common, namely marked tissue retraction, inversion, displacement, extensive scarring, difficulty in formative restoration, asymmetric healing, involvement of facial expression, distortion of adjacent appendages and late general facial deformity. As stated heretofore, these are due to the complex interrelationship and interdependency of its many anatomic components and its surrounding appendages. When to this is added the varied kinematic function of the cheek, the need for meticulous repair becomes apparent. Its manifold kinematic functions are best represented in its relationship to mastication, deglutition, speech, whistling, laughter and its other subtle activities. Hence any trauma to the cheek resulting in a tissue void is a functionally costly and surgically important injury.

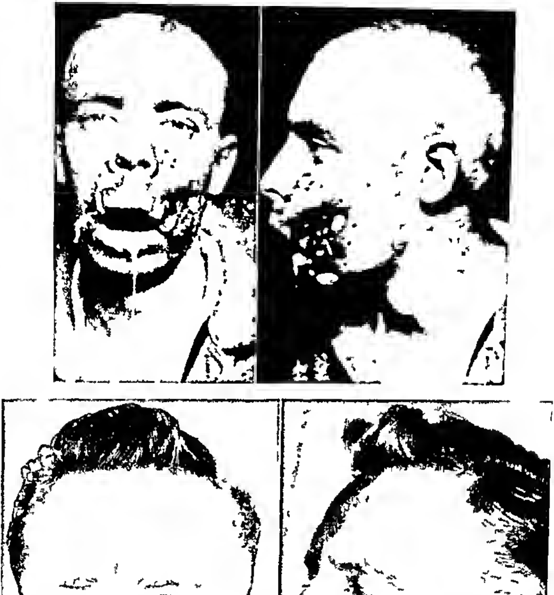

FIG 238 (*Left*) Cheek repair three months postoperative showing results of ordinary coaptation closure of wound (*Right*) Exaggeration of cheek repair necessary to avoid eventual postoperative retraction (notorious in cheeks) as shown at left

METHODS OF RECONSTRUCTION

Superficial Voids All skin voids of the cheek unless of a minor degree should be reconstituted by the inshifting of tissues from the region of the mandible or the neck Free grafting of the cheek area may result in conspicuous patching of the face When a free graft is unavoidable as in the scarring of collateral skin a full thickness free graft should be used never a split graft

When tissue is shifted in from the area of the mandible or the neck all the underlying subcutaneous fat should be brought in with the transported tissue In actual practice it is rather difficult to overpad the cheek area If one must err it is better to do so on the side of overpadding rather than the reverse (Fig 238 right)

When suturing in the cheek area the line of suture should always be exaggerated in overcorrection to a reasonable maximum Cheek repairs are notorious for eventual flattening if not actual retraction (Fig 239) This is due in part to the potential anatomic spaces of the cheek area as emphasized by J G Kostrubala lack of rigid support and vulnerability of the adipose contents The constant mobility of the part only adds to tissue flattening

Under no conditions must a laceration or a graft applied to the cheek be sutured with even minimal tension upon the lower lid or corner of the mouth Such tension while relatively negligible at the time of operation will with healing scar tissue deposition and organization become augmented to the

FIG 237 Consequences of through and through gunshot wound of both cheeks and appearance of repair by collateral tissues one year postoperatively (For immediate results obtained by coarctation see Fig 64) Note balance of mouth in profile view with no distortion of angle after late revision

Fig 239 Left parotid duct following injection with lipiodol X ray studies of the duct should be taken in the three positions the two shown above and the mental position Note opaque shadows of even the minute ramifications of the duct within the gland

point of distorting the collateral appendages and therefore facial expression Where some tension is unavoidable in the closure of relatively large cheek voids it is necessary to do an immediate tarsorrhaphy or cheilorrhaphy or countenance the price of many subsequent reconstructions of the lower lid or the upper lip

Deep voids of the cheek imply the possibilities of facial paralysis injury to Stensen s duct involvement of the parotid gland and the muscles of expression Where major ramifications of an injured facial nerve can be identified in a wound at the time of original repair or the first reconstructive procedure they should be resutured Where injury of the parotid gland exists the capsule should be repaired and pressure dressings should be applied postoperatively The diet in such cases should be bland and non stimulating There is little restitution for the loss of muscles of expression except to borrow and transpose ribbons of the masseter or temporalis to the angle of the mouth or the eyelid respectively (see Facial Paralysis Chap 30) The repair of Stensen s duct is important in the avoidance of a parotid fistula

Parotid Fistula If a parotid fistula occurs following a cheek injury the duct may be probed preoperatively to ascertain its patency This should be done with a very fine thin and flexible probe which is gently insinuated into the intra oral meatus of the duct Where this cannot be done with obvious ease the duct should be injected with 1 5 to 3 cc of iodized oil and checked by X ray studies The injection is best accomplished with a smooth blunt end 24 gauge needle insinuated into the mouth of the duct for a distance of 2 or 3 mm (Fig 239)

Parotid fistulae are usually divided into two types fistula of the duct proper and those of the glandular portion These divisions are based upon the fact that the treatment of the two types is totally different In general it may be said that exten

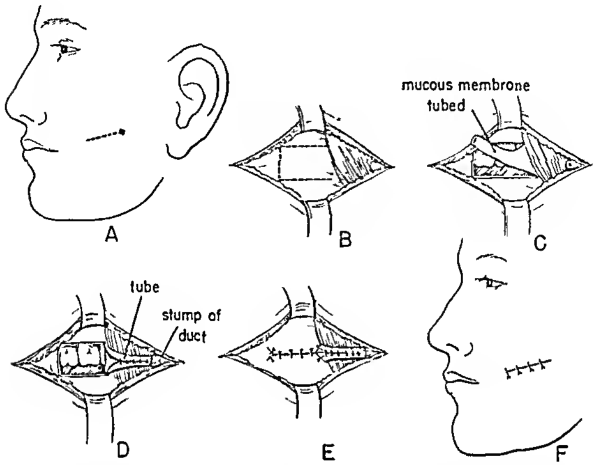

Fig 240 Method of reconstruction of parotid duct (A) Fistula with proposed incision (B) Outlined flap of oral mucosa anterior to masseter (C) Mucosa tubed epithelial surface inward (D) Tubed mucosa sutured to stump of duct (E) Surgical defect in oral mucosa closed (F) Skin incision sutured

sive injuries of the cheek almost always result in ductal fistulae Should there be any question about the type of the fistula, the injection of iodized oil into the meatus and X raying of the cheek, as indicated above, identifies the location of the injury Where a case comes to hand early after injury and complete original repair is advisable the severed ends of the duct may be sutured end to end When this is done a flexible thin walled rubber catheter should be introduced into the meatus and passed up through the duct as far as possible before suturing the duct The catheter should be left in place for a minimum of four days If this is not feasible and a fistula follows, one is at least fortified by the knowledge gained during the original care of the case as to where the duct has been severed whether anterior to the masseter muscle or in its glandular segment

Where the fistula lies anterior to the masseter muscle an elliptical incision is made about the fistulous opening and by meticulous dissection the duct is mobilized in the direction of the masseter as far as possible An opening is then made directly through the cheek wall into the oral cavity, and the end of the duct is brought through the opening and sutured to the oral mucosa The external incision is then closed without tension Where the duct or any portion

FIG. 241. (*Left*) Radiodermatitis of cheek. Scar over mandible resulted from spontaneous breakdown with only partial healing. Note atrophic avascular area over greater portion of cheek. (*Right*) Restitution by flap advanced to cheek from neck. Note modified "Z" beginning at lobe of ear and running down onto neck. Mandibular arm of "Z" practically invisible 2 months postoperative (see "Closure of Arched Defects," Chap. 21).

thereof cannot be isolated, the catheter may be brought up from the mouth into the fistulous opening whose edges are then freshened and the skin closed. This redirects the salivary secretions into the tube and thence into the mouth. The area about the catheter epithelializes with time, and the catheter can be gradually removed until a permanent intra-oral fistula remains in substitution for the duct proper. To insure patency, do weekly soundings for 3 to 6 months.

Where neither one of the aforementioned two procedures is possible, a new duct must be formed. This is made from the buccal mucosa. An incision is made anterior to the fistulous opening somewhat longer than the thickness of the cheek. This incision should extend down through the subcutaneous fat. The buccal mucosa is then bared, and two parallel incisions are made in it at least $\frac{3}{8}$ inch apart. These two incisions are then connected anteriorly so that a flap of buccal mucosa results. This flap can then be tubed with the mucosal surface inward so as to form a permanent lining, and the free end of this tube is sutured to the remains of the duct in or about the region of the masseter

The oral incision is closed, and the jaws are immobilized by simple interdental wiring (Fig. 240).

Fistulae of the gland proper are usually much easier to handle than those of the duct. The simplest way is to cauterize the fistula and apply pressure. If this is not satisfactory the fistula should be excised, the wound edges freshened and carefully sutured. Even in these cases immobilization of the jaw for a period of 19 days by intermaxillary wiring is advisable

Perforating Voids. Two features are injected in perforating voids of the cheek which are never a problem in the other types of voids. One is the restoration of the lining of the oral cavity and the other is the common occurrence of associated jaw contractures Both of these may be repaired at the same time. The restoration of the lining of the oral cavity is usually accomplished by means of intra-oral flaps of mucous membrane Where this is not possible, cheek flaps may be turned in on a peduncle to subserve the function of a lining. The latter is not to be advised in the male because of the probability of beard growth within the oral cavity. It is, therefore, the custom to bring in tissue from the lower neck or clavicular regions in the form of a pedicle or a tube

Where adhesions exist between the cheeks, lips and jaw bones coincident with *destruction of the lining of the mouth, these* adhesions must be excised and the raw surface covered by free skin grafts or by buccal inlay, the so called Waldron-Esser method. No time should be wasted in the mere transection or stretching of intra-oral adhesion and contractures, since the results are almost always disappointing Once the buccal inlay is completed, the free skin graft used

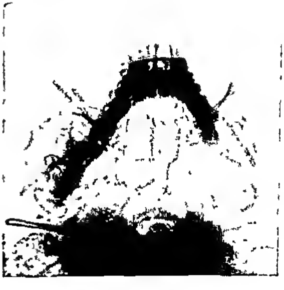

Fig 242A (*Top*) Compound deep reconstruction of cheek. Deep cheek plus jaw deformity 19 years after accident The latter resulted in complete atrophy and flatness of cheek as well as the entire mandible The mandible was very thin and sclerotic Family surgeon attempted, 14 years after accident, correction of deformity by inserting bars of preserved cartilage which resulted in lumping and *deformed appearance of cheek as shown* in photograph (*Bottom*) Roentgenogram of lower jaw after removal of cartilage and 4 months after iliac onlay graft from condyle to symphysis Note circumferential wires over graft.




as a lining must be kept in a condition of stretch for long periods of time to avoid shrinkage and obliteration of the newly formed labial cul-de-sac (3 to 8 months)

DERANGEMENTS

Superficial

From the standpoint of surgical diagnosis cheek derangements whether segmental or general in character comprise distortions displacements or misplacements But from the standpoint of repair these may be subdivided into superficial and deep Although accidental tissue displacements of the cheek are unavoidable because of its anatomic peculiarities surgical misplacements due to careless repair are too common and constitute the main reason why plastic reconstruction is so frequently necessary in these cases after the original repair (see Figs 36 53 and 460)

Superficial derangements of the cheek are usually comprised by scars port wine marks and pigmentations Unless these involve more than 15 to 20 per cent of the cheek area they can usually be excised in toto and the surgical defect closed by the inshifting or rotation of collateral skin (Fig 241) Where the superficial derangements involve more than 20 per cent of the cheek they still may be repaired without grafting by repeated partial excision of the lesion and coaptation of the lips of the defect (See Chap 18 Surgery of Scars under the heading of repeated partial excisions)

Where the entire cheek area is involved the Esser rotation flap or some modification thereof may be used to provide coverage for the cheek

Deep

Deep derangements of the cheek area are usually neurogenic vascular or neoplastic in origin and may be associated with loss of bony support of the face or the absence of normal fatty tissue content resulting in the so called hollow cheek Their reconstruction is entirely dependent upon accurate diagnosis of the etiology involved and the timbre of collateral parts Whenever such operations are performed on deep derangements of the cheek again it must be called to the student s attention that the surgical entry in itself is a form of trauma and tissue derangement Therefore it must be a planned and meticulous procedure taking these factors into consideration Where such derangements are due to loss of bony support or the absence of adequate amounts of fatty tissue these must be brought in In the case of bone this obviously can be introduced in the form of a free graft But in the case of absence of adequate fatty tissue padding of the cheek the use of free fat grafts is discouraged Much better and more reliable results are obtained by the importation of the fat in the form of a tubed pedicle Such a tube when brought into apposition over the cheek is denuded of its epithelium and outer layer of derma whereupon the tube is opened (after excision of its suture line)

Fig 242B Compound deep reconstruction of cheek (*Continued*) (*Top left*) Patient represented in Figure 242A 8 months after total onlay graft of right mandible from condyle to symphysis Donor site left iliac crest Note acromiosternal tube carrier of cheek padding Whereas mandibular form was comparable to other side bone graft was only covered by skin and cheek area was still flat and sunken in as indicated by para nasal shadow (*Top right*) A method of grafting fat into cheek in tube form Acromial extremity of tube jumped to nasolabial crease (*Bottom left*) Tube fat shown tunneled into cheek After decortication of tube transection opening and spreading of same it was tunneled into cheek through two buttonholes one made over angle of jaw and the other perorally (*Bottom right*) Final complete implantation of tube fat into cheek by decorticating peduncles of outer layers of skin and burying them subcutaneously (Compare with 242A top)

and the fat covered by derma is insinuated into the cheek by means of appropriately placed buttonholes (See Fig 242, Author's method)

EXCESSES

True

True tissue excesses of the cheek, for the most part, consist of fat deposits hyper trophies and senile ptosis These are covered in Chapter 30, and under Rhytidectomies

False

Tissue excesses of the cheek area may be due to parotid involvement, hemangiomas, neoplasms, hyperplastic suctorial pads, lymphatic conditions or neoplastic bony support (see Figs 19 and 31)

All tissue excesses of the cheek have one thing in common and that is the need for carefully planned and meticulous excision of the tissue responsible for the swelling in such wise that the relationship of the cheek to surrounding appendages and their esthetic value are not compromised Since cheek swellings are so commonly associated with systemic intra oral or infectious diseases, a reliable diagnosis is indispensable to adequate surgical prosecution of these cases Where the offending pathology involves the major portion of the cheek and particularly the lining of the mouth tissue pedicles should have been prepared elsewhere, as for instance in the cervical region and migrated into the vicinity of the cheek in preparation for immediate reconstruction of the surgical defect consequent upon excision of the pathology This is not done as a rule where the offending lesion is malignant In the latter case it is best to excise the lesion completely and approximate the mucous lining of the mouth to the skin of the cheek so as to avoid scarring and retraction of the remaining cheek tissue (Fig 84) This facilitates later repair and can be accomplished at much less tissue cost than if considerable postoperative scar has to be excised from a cheek wound whose edges have been left raw This applies as well to acute accidental losses Such raw areas invariably become infected only adding to the nursing problem because a fundamental principle in plastic surgery has been disavowed

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27

Ears (Otoplasty)

Although the functional importance of the auricle from the standpoint of hearing is a minimal one, its esthetic value remains unquestioned. Consequently, any and all surgical procedures executed upon it may be considered basically esthetic in nature.

Plastic reconstitution of the auricle, whether it be total or subtotal, is difficult for three reasons: first, the intrinsic contours of the appendage are of a kind difficult to mimic or reproduce; secondly, the standard of reconstruction can only be the other ear, which implies perfection of reproduction; and finally, the unsuspected volume and kind of skin necessary for reconstruction of the ear is such that the donor site is relatively difficult to find and the tissue cost is high. Although it is not impossible with considerable experience, imagination and patience to create a fairly acceptable representation of an ear, no one has yet succeeded in making an appendage equal in detail and quality to its mate. Anything less than that remains a surgical substitute. Notwithstanding, the necessity remains for the attempt to be made in the reconstitution of a damaged or absent ear, because of the obviousness of its absence and the psychological effect upon the victim. This is particularly true in the male.

Ultimately the student must realize that total otoplasty is still in the formative stage and that the problem has not as yet been reduced to the common denominator of standardized approach. When this stage in the development of total otoplasty will have been reached, it will not by any means imply the final solution of the problem for two reasons. First, the matter of identical reconstruction apropos the good ear will remain. Secondly, because of the greater variability of factors involved in the traumatic cases, in contrast with congenital absence of the auricle, there is almost always some involvement of the tissues about the lost auricle so that only partial opportunity exists for the utilization of the tissues most suitable for the reconstruction. In congenital absence of the auricle, this disadvantage seldom exists because the tissues collateral to the absent ear are almost always of normal timber and integrity.

VOIDS

TOTAL

There are two types of material necessary in the total reconstruction of an auricle, one is the soft tissue and the other is the supporting structure (Fig. 243).

All manners of approach to the creation of an ear have been tried by various surgeons the world over. The innumerable procedures described in the literature for total reconstruction of an ear may be reduced to six basic approaches. The first is the elevation of an oval flap of skin from the mastoid region at least equal in extent to the normal ear, free grafting of the resultant raw area, the deposition of cartilage under the lining of the flap, and final attempts at molding. The second approach resides in the making of a tubed pedicle, usually in the cervical region, migration or waltzing thereof to the normal auricular site, arrangement of the tube into the shape of an auricle and insinuation of cartilage. The third approach is usually a combination of the first two (Fig.

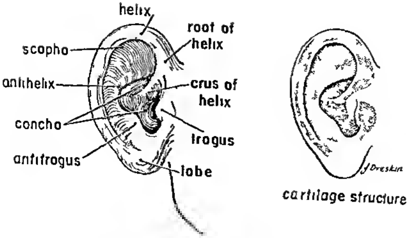


FIG 243 Complex contour and details of normal ear and relation of cartilage support to overlying soft tissues

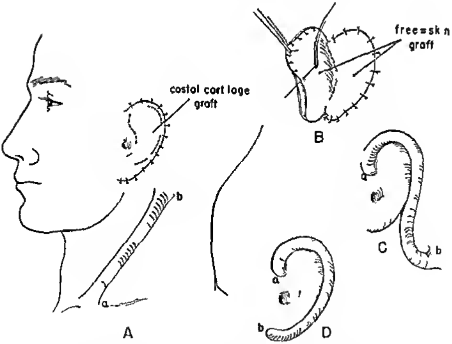


FIG 244 Conventional method of total otoplasty (A) Elevation of mastoid flap implantation of shaped cartilage and construction of cervical tube (a b) intended for helix (B) Free grafting of raw surface of mastoid flap and *donor site over mastoid with split graft Note running suture* anchoring free graft into angle between mastoid flap and donor site to maintain graft in depths of wound (C) Jumping of cervical flap to superior pole of ear and beginning of helix *(D)* Finished ear *The simplicity of the* illustration of the finished ear is quite representative of the quality of an actual ear made by this method An appendage thus created has very little character and never approximates its mate

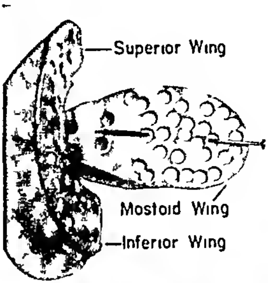


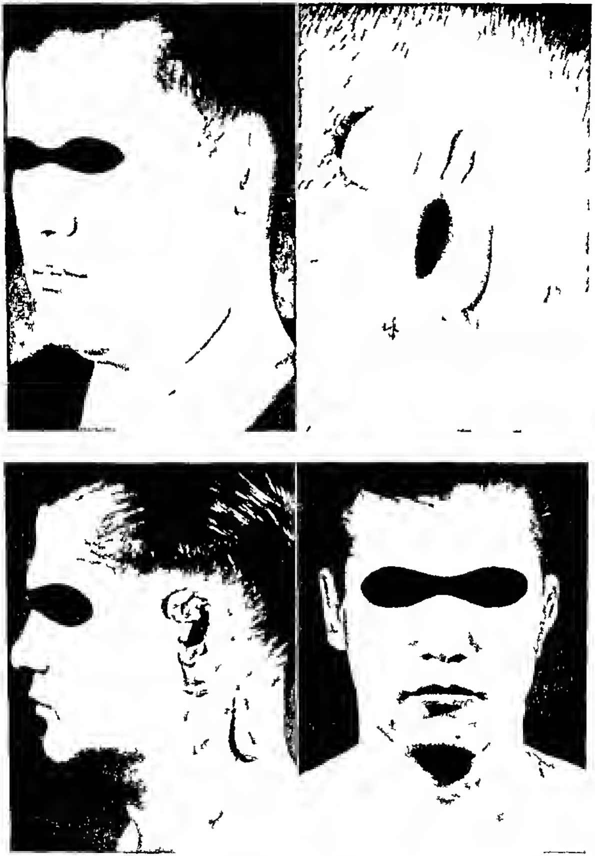
Fig 245 A Total otoplasty by means of a cephalo cervical flap (*Top left*) Case of total traumatic loss of right ear with the exception of the root of the helix At this stage the neck flap has been doubled posteriorly so that its peduncle becomes the anterior aspect of the ear The surgical defect in the neck after rotation of flap was closed by undermining and direct approximation as illustrated by linear scar leading from lobe of new ear downward At the time that the flap was doubled back on itself a temporary perforated tantalum support was inserted and sutured into the mastoid (*Top right*) *Extemporaneous tantalum support* used to prevent shrinkage and atrophy The support is designed so it has a mastoid and auricular wing The auricular wing turned at a 70 degree angle to the mastoid wing is usually about 5 cm in height It terminates in a superior wing which supports the upper pole of the new ear and an inferior wing which reaches into the future lobe (*Bottom right*) Angle of incidence of auricular tantalum support to mastoid as shown in A P x ray As a permanent support inanimate material is not to be used

244) The fourth and rarely employed approach is the formation of a more-or less earlike appearing appendage elsewhere on the body such as the pectoral region or the undersurface of the arm and the migration of this crude appendage to the site of the premastoid region The fifth basic approach to total otoplasty is based upon an extensive cephalocervical flap (Fig 245 also 120J) The flap is designed so that its peduncle rests at the site of the intended ear its free pedicled end terminating on the neck

FIG 245B Total otoplasty by means of a cephalocervical flap (*Continued*) (*Left*) Anterior view of folded cervical flap containing tantalum implant 6 weeks postoperative At th s time the metal support may be removed and shaped pieces of cartilage inserted with molding of the ear (*Right*) Appearance of ear two months after cartilage implants Further detailed molding of skin indicated (see also Fig 120J)

in the region of the lower third of the sternomastoid muscle This flap is made in two stages the first is a delaying stage which is then picked up and doubled under In this way the distal pedicle becomes the posterior facies of a double flap from which the ear is made as illustrated in Figure 245 The *sixth approach frequently employed* by the author is the serial segmental construction of individual anatomic segments of the auricle from tissues available in the region of the future ear the eventual augmenting of this soft tissue framework by a cervical tube for purposes of the helix and the final insinuation of cartilaginous support to maintain the semblance of an auricular appendage The last named approach needs far more imagination meticulousness planning and patience than the other five but usually results in a more substantial and reasonable appearing appendage (Fig 246) A variation of the last approach is a *combination of the fifth and the sixth methods* which in the author s hands thus far has

FIG 246 Author s procedure for segmental total otoplasty (*Top left*) Congenital absence of left ear with basic ear segments formed also cervical tube destined for helix (*Top right*) Appearance of ear segments 6 weeks after removal of sutures Note their buried appearance about the reconstructed external acoustic meatus (*Bottom left*) Auricular segments assembled into scaphal and conchal portion with cervical tube draped around periphery Basic cartilaginous supports inserted but not joined as yet Supplementary tube on neck needed to augment lobular part of new ear (*Bottom right*) Left ear all but totally reconstructed Helicine fossa needs slight freeing at tail end to permit helix to bear out in more even fashion Note particularly good height and allocation of ear as well as angle of incidence of helicine root



resulted in the best mimicry of the auricular appendage (Figs 247 and 248) It is improbable that a simple standard method for *otoplasty can ever be anticipated*, except in congenitally absent auricle, because trau

There are three sources *most often* resorted to for the supporting structures of the ear One is autogenous cartilage, the second is homogenous cartilage, and the third, which has been given fair trial by plastic

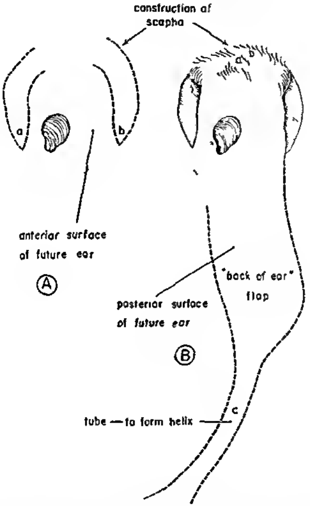


Fig 247A Combined method of total otoplasty (Pick's) (A) Formation of scaphal segments by mobilizing a premeatal and mastoid flap which are then tunneled under the *skin below hairline so that their extremities cross as indicated* (B) Outlining of cephalo-cervical flap continued as a cervical tube which latter is to form helix (See Fig 248)

matic loss so often involves derangement of collateral tissues thus excluding the possibility of reconstruction by local flaps Six approaches *to the acquisition of only the* soft tissue from various regions collateral to the future ear have thus been indicated

surgeons *in World War II is tantalum* in the form of thick foil or mesh The last has beeo used by the author in several cases *during World War II and found wanting* The most formidable objections to the use of tantalum in the total reconstruction of

the ear are two: one is basic, namely, that any and all foreign materials are more-or-less inimical to satisfactory reconstructive surgery; second, tantalum no matter in what form it is employed or how it is is that based upon the cartilage of the mother's ear. The proposition was originally suggested by Sir Harold Gillies of London. Homocartilage, taken from other sources, is of questionable integrity.

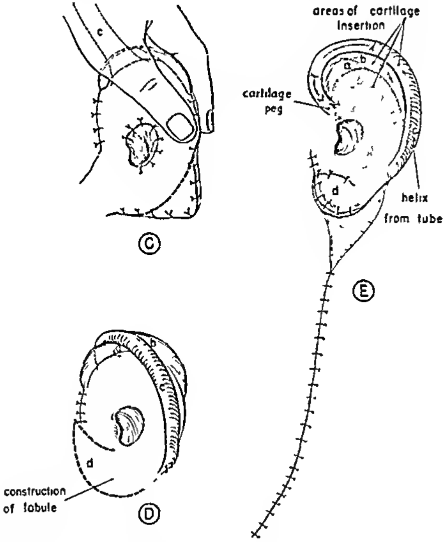


Fig. 247B. Combined method of total otoplasty (Pick's) (*Continued*) Completion of the ear

shaped and prepared, sooner or later is extruded by the auricle.

Homocartilage has been extensively employed and is still being used by some surgeons, with only a fair degree of success The most successful use of homocartilage

Autogenous cartilage may be used in one of three forms. The skeletal framework of the auricle may be sculpt out of one piece of cartilage, which is a difficult feat and few surgeons are equal to it Ultimately, it is a question whether or not the difficulties of

FIG 248 (*Left*) Appearance of cephalocervical flap in this case partially tubed with cervical tube Note closure of donor site in neck by modified Z plasty accomplished through application of method for closure of arched defects (Chap 21) (*Right*) Application of combined cephalocervical flap terminating in cervical tube in major subtotal reconstruction of auricle At this stage both flap and tube have been rotated upward (cf Fig 247 C and D) The flap is shown in place for construction of concha whereas tube has already been draped to indicate its function as a helix Large inframeatal nipple of skin intended for lobule has been accomplished by rotating pre-auricular triangular flap downward and doubling it upon itself (d in Fig 247D) In this case donor site for cervical flap has been free grafted

the task are exactly worth the effort The same results may be accomplished by a second method commonly employed and that is the insertion of autogenous cartilage in separately sculpt segments one for the helix another for the antihelix another for the concha and a separate piece for the tragus These may be inserted after the entire auricle has been prepared in terms of soft tissue or they may be inserted from time to time as the organization of various parts of the ear permit This depends upon the basic procedure employed in the construction of the soft ear that is whether it is made from a single flap several small flaps and a tube or entirely constructed out of a tube

A third manner of employment of autogenous cartilage in a total otoplasty is the use of diced or ground cartilage This is a

PLATE 10

(*Top*) Typical illustration of traumatic (burn) loss of upper pole of ear with distortion and peri-auricular scarring; the latter precludes restoration by contiguous tissues Note the cervical tube attached to the site of the root of the helix and ready for final transfer (*Bottom*) Ear reconstructed from cervical tube with cartilaginous support inserted seven days before Note good size, position and form of ear.

method recently popularized by Forrest Young, Lyndon Peer and Gustave Aufricht. The cartilage bar after being mobilized from a rib is diced and then implanted subcutaneously in the chest or the hypochondrium in a metallic or acrylic negative constructed to more or less mimic the details of the ear. After ingrowth of fibrous tissue into the diced cartilage and organization of the mass, the latter is removed, all superfluous tissue cut away, additional detailed moulding attempted and the mass is insinuated into the soft tissues comprising the auricular appendage. The basic concept is an interesting one. It is a method given trial by the author in 1936 when with the aid of Dr. R. K. Richards of Abbott Laboratories a special cartilage grinder was devised. The method was soon abandoned for two reasons, one an immediate and the other a presumed one, namely that it took too long for the ground cartilage to organize (from five to eight months) and that since the ground cartilage was altogether subject to the unpredictable eccentricities of the ingrown fibrous tissue, not much reliance could be placed upon the final maintenance of form of the finished ear. Peer and Aufricht seem to be more optimistic. It is a procedure deserving of attention as to its three to five year outcome.

The cases which present themselves for total otoplasty must be divided into two categories, the traumatic and the congenital absence of the auricle. This is unavoidable because all total reconstructions are at one time or another based upon the utilization of the skin in the region of the missing appendage. In the traumatic case this advantage is often absent due to the fact that coincident with the loss of the appendage a degree of scarring follows the accident involving the skin of this region, thus partially or wholly destroying the integrity of the tissue and so depriving the surgeon of that advantage. This dictates the necessity for importation of tissue from regions sometimes remote from the site of the construction. The ultimate result may be a compromise of the color quality of the new ear.

FIG. 249. The patient shown had bilateral destruction of the auricles due to third degree burns. Only available tissue in the vicinity was that represented by already formed lobule and small tube lying transversely across the region of the antihelix. It was therefore necessary to import considerable tissue for reconstruction of both ears. For this the "nuchal" tube was conceived as shown surrounding back of the neck. The extremities or peduncles of the tube lie in the region of the suprasternal notch. The tube is constructed in two steps separated by a temporary peduncle left in the nuchal region until through and through circulation of the tube is established. The tube is then split posteriorly into two pedicles, each one of which is then jumped to the ear on the same side. (Tubes running across body midline must be carefully nursed.)

In congenital absence of the auricle col

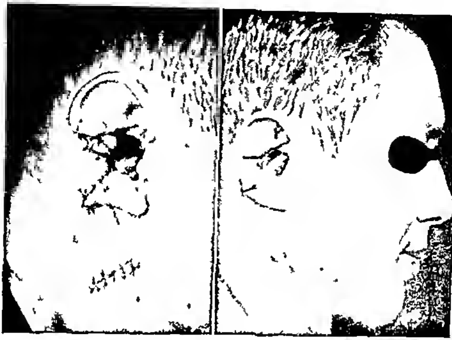


FIG 250 (*Left*) Construction of external acoustic meatus by free grafting The rim of meatus augmented by crossed flaps procured from mastoid region Incision below ear is atrium made for lining of infralobular flap intended for construction of concha Flap to be doubled up on itself as in Figure 247 (*Right*) Concha completed Detailed revision of ear still indicated

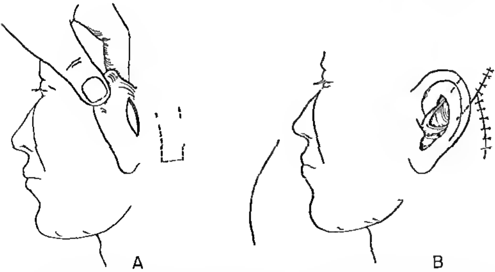


FIG 251 Bouisson procedure *for construction of auricular canal* (*A*) *Outlining of* mastoid flap and through and through buttonhole incision of ear through which flap will be rotated (B) Flap being tubed rawside out rotated through auricular buttonhole and about to be inserted into meatal sinus prepared for it

lateral scarring does not exist and therefore full and complete advantage may be taken of whatever skin is available in the region of the mastoid and the angle of the mandible The disadvantage of using skin in the vicinity of the future ear is that incisional scars will remain detectable on the exposed skin of the neck

Hence all procedures from the standpoint of initial approach may be divided into two types those which are based upon the utilization of tissues in situ plus whatever additional tissues may be necessary to complement the former and those which are based entirely upon the utilization of tissues remote from the auricular region

Whether a total otoplasty is begun with tissues unharmed and normally present in the region of the future auricle or whether the reconstruction is based upon the importation of tissues from other regions different surgeons approach the subject with a different surgical blueprint One surgeon may raise a single pedicle flap in the auricular region, outlined in accordance with the general shape of the auricle and implant a shaped piece of cartilage under it The flap is then sutured back into its donor site to establish communion between the skin and the cartilage When the flap is re elevated with its supporting tissue a split graft is applied against the raw surface of the flap and the raw area on the donor site Other surgeons use more or less the same basic approach except that the flap is not cut necessarily to resemble an ear but rather to fulfill the proposition of self lining and avoidance of delay In the latter case the supporting structure is usually inserted between the two layers of the self lined flap later Personally if possible I prefer to construct the auricle more or less piecemeal by creating its various anatomic segments out of separate local flaps and adding one onto another as healing and organization permit until the entire auricular appendage is constructed As each and every

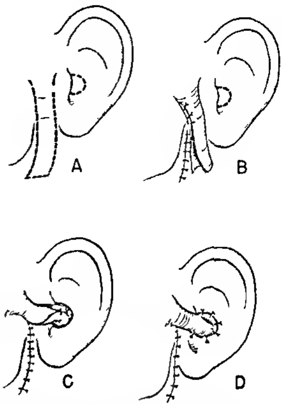


FIG 252 A procedure for construction of the auditory canal (A) Outlining of donor site for tube as well as location for creation of meatal sinus (B) Closure of pre auricular tube (C) Inversion of tube and its insertion into the prepared sinus This may be done in one stage or in two depending upon tissue integrity Method of immobilizing extremity of tube within auricular sinus described in text (D) Inverted pre auricular tube *sutured to rim of auricular sinus*

segment becomes organized an individual and appropriate shaped piece of cartilage is inserted As the segments take form one after another other segments are added in a sequence and size consistent with the anticipated ear The process is terminated by the addition of the helix

In the cases where the auricle has to be constructed out of tissues imported from other than the mandibulomastoid region the plan is usually one based upon the tubed pedicle In general the more distant the donor site from the mastoid region the more

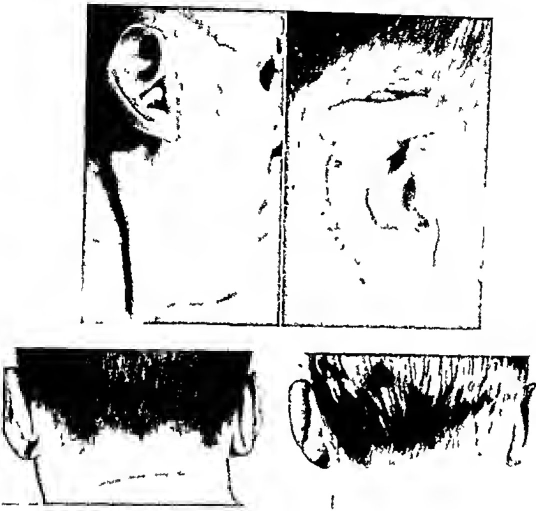


FIG 253A Bilateral reconstruction of helix via cervical tube (*Top, left*) Cervical tube intended for construction of helix Incidentally external auditory meatus shows migrated postauricular tube inserted for reconstruction of ear canal (*Top right*) Tube waltzed to superior pole of ear with inferior pedicle oriented in region of root of helix Note meticulous apposition to antihelix an important esthetic detail (*Bottom, left*) Retroauricular position of cervical tubes pending development of adequate circulation prior to construction of helix (*Bottom right*) Appearance of reconstructed ears posterior aspect Note mimicry of normal posterior contours of the auricles

probable it is that the tissues must be introduced in the form of a tube This is due to the fact that the tube is the safest most practical and reliable way of transporting relatively large masses of tissue over long distances involving extended periods of time (Fig 249)

Whenever the site for the construction of an auricle is involved by considerable scar tissue it is good practice to excise the scar tissue completely and replace it by a thick split graft This is in obedience with a basic principle in plastic surgery discussed in an earlier chapter It helps to augment the

Fig 253B Bilateral reconstruction of helix via cervical tube (*Continued*) (*Left*) Helix completed with thin strip of cartilage inserted The extremities of the latter are sutured into the cartilage of the antihelix and the rim of the scapha respectively (*Right*) Anterior view of same patient Note balanced position and height of both ears (For appropriate ear dressing see Fig 74A *left*)

circulatory supply of the recipient site as well as to improve the general timber of the collateral skin and therefore improves the chances of the ultimate success of the entire venture

An additional complicating feature in the total restoration of an auricle is the question of the external auditory meatus Where this is absent as is often the case, it must be recreated first before any attempt is made at the reconstruction of the auricle proper This is only functionally feasible where the integrity of the middle ear can be established by planigrams and sound tests Where the middle ear is absent the construction of an external auditory canal is of no functional consequence but for esthetic reasons an attempt should be made nonetheless to mimic the external meatus This may be accomplished in one of three ways by free grafting of a previously prepared tunnel mimicking the canal the Bouisson procedure of raising a mastoid flap which is tubed raw side out and insinuated into the prepared tunnel or the preparation of a cervical tube which is opened and resutured skin surface inward before implantation (Figs 250-252) For discussion of methods see External Auditory Canal and Meatus under Partial Voids in this chapter

The final consideration in total reconstruction of the auricle is the question of the time element allowable for construction From a psychological standpoint it seems necessary to make some attempt at the construction of an auricle as early in life as possible to avoid ridiculing of the young patient by his playmates From a practical surgical standpoint this does not solve the problem because the appendage constructed

early in life does not keep pace with its mate and therefore needs augmenting when the individual has attained puberty or young manhood

In actual practice the first step in the case of a young child consists of maximum dissection freeing and allocation of such segments of the undeveloped ear as may be present They are often inadequate or useless in the reconstruction but only exploratory surgical evaluation will tell At other times an amazing amount of tissue is thus

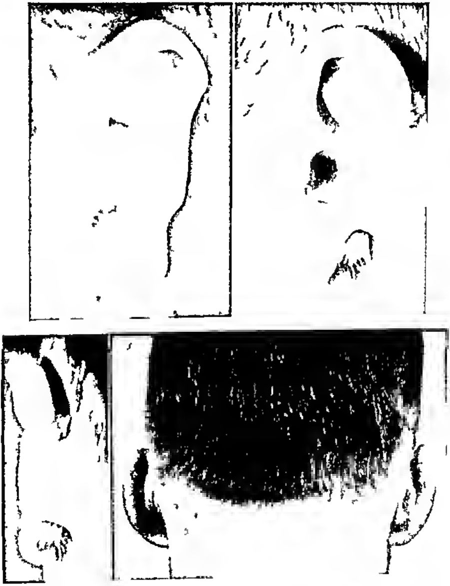


Fig 254 Construction of helix via mastoid flap (*Top left*) Typical case of subtotal loss of helix (*Top right*) Method of reconstruction of helix by imbedding of rawed edge of ear into mastoid region (*Bottom left*) Posterior view (*Bottom right*) Same case as A showing bilateral reconstruction of the helix with thin cartilage strip inserted

gained plus a proper original allocation of the future ear Whatever raw areas result from the latter must be free grafted for the time being

Prior to the child s admission to school a lobule may be added although this is more frequently present in congenital microtia than other parts of the appendage Coincident with the lobule a helix should be appended via a cervical tube This usually helps in tiding the child over the psychologically most vulnerable period in life When he reaches the age of ten or more total re-evaluation and final reconstruction may be planned

From the foregoing basic considerations

FIG 255 Construction of helix (and antihelix) via postauricular flap (*Left*) Rolling of postauricular skin anteriorly (*Right*) Reconstruction completed with cartilage inserted

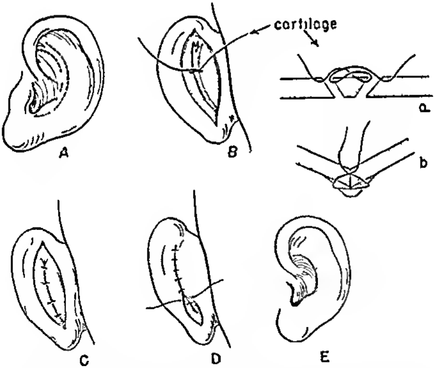


FIG 256 Method for the construction of the antihelix in shell ear (lop ear) No cartilage need be excised in the average case by this method providing the parallel incisions are properly placed and the sutures properly allocated The retention of the cartilage intervening between the incisions (see a and b) augments prominence of the antihelix and obviates an anterior skin fold unavoidable in most procedures based upon cartilage excision Where the latter is unavoidable a through and through resection of skin and cartilage is preferable (see Fig 257)

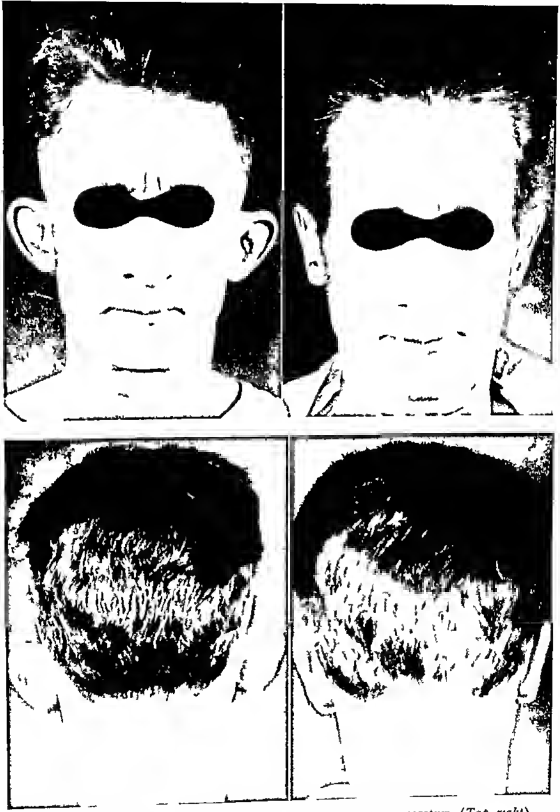


Fig 257 Congenital lop ear (*Top left*) Anterior view preoperative (*Top right*) Anterior view postoperative (*Bottom left*) Posterior view preoperative (*Bottom right*) Posterior view five years postoperative

concerning total otoplasty the student must realize that the total construction of an auricular appendage is a problem not only involving physical anatomic and technical considerations but one which might be classed with the more extensive psychosomatic problems In actual practice this is borne out in almost every case

PARTIAL

Helix Undoubtedly the most common injury to the ear is the loss of the helix or a part thereof This is notoriously the case in thermal injuries of the ear

There are three basic approaches to the construction of the helix (Fig 253) One and probably the most commonly employed resides in the construction of a cervical tube of appropriate circumference and length and migration of the tube to the rim of the remaining portion of the auricle After its allocation in front of the superior pole of the injured ear and above the posterior rim of the lobule the tube is opened on the underside and sutured to the auricle At a later date this may require insinuation of a thin rod of cartilage which is usually obtained from the scapha of the other ear if the latter is a large one

The second method is to excise the scarred rim of the injured ear make an appropriate convex incision in the region *anterior to the mastoid so that the raw* edge of the injured ear can be sutured into the incision When complete healing and organization has taken place another similar incision is made somewhat posterior to the original and consistent with the tissue requirements for the construction of a helix The tissues are then undermined anteriorly until the ear is completely freed The mastoid tissue thus added onto the injured ear can then be folded on itself and sutured posteriorly into the auricle so as to resemble a helix (Fig 254)

Another method sometimes employed is to make an incision in the cephalo auricular sulcus of the injured ear through the entire thickness of the skin down to the perichondrium undermine this posterior auricular skin to the free edge of the auricle roll it out toward the edge so that the flap remains doubled upon itself and then suture the advanced cut edge of the flap to the back of the auricle so that a Helicine rim is made about the injured ear The raw surface remaining on the back of the auricle is then covered by a free split skin graft After *the lapse of five or six weeks or more a thin* strip of cartilage may be inserted into the newly created helix to maintain its form This procedure carries with it considerable circulatory risk is only seldom employed and is not to be recommended for routine use (Fig 255)

FIG 258 Reconstruction of helix and antihelix via cervical tube Tube doubled upon itself with lower half of tube destined to form antihelix and upper and outer half of tube for helix A indicates point of transection so inner segment of tube may be rotated medially and outer segment can be attached to lobule

Antihelix An ear devoid of its antihelix almost invariably implies the absence of the helix Where the helix is present the tissues for the antihelix are also present but not formed This is only true in the congenital lop ear

The basic approach to the reconstruction of the antihelix in the congenital case is to make an incis on on the back of the auricle

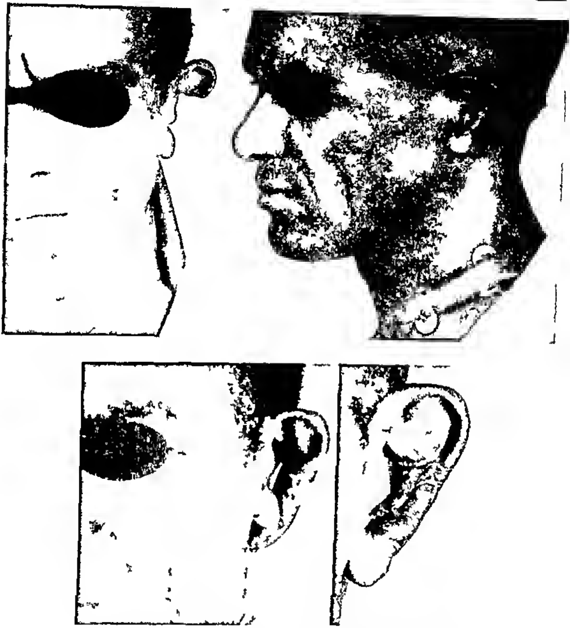


FIG 259 Method of reconstruction of the antihelix concha and helix by the use of cervical tube (*Top left*) Traumatic loss of anti helix concha and tail of helix Cervical tube already in process of migration (*Top right*) Lateral view of ear deformity Cervical tube at time of its making Buttons under tube carry fine wire mattress sutures for reenforcement of donor site closure These are removed on the fifth day (*Bottom left*) Cervical tube shown migrated to ear defect (*Bottom right*) Anterior view of completed soft tissue repair Contrast difference in pigmentation of repair and remainder of ear a frequent phenomena in colored races Insertion of cartilage will augment the ear

more or less in line with the polarity of the future antihelix excise a wedgelike ribbon of cartilage on each side of the line of the antihelix and approximate the lateral lips of the cartilage over the unexcised central segment of cartilage The amount of cartilage to be excised is entirely dependent upon the height of the superior pole of the ear (Figs 256 and 257)

The most commonly employed procedure in the reconstruction of the antihelix in traumatic voids is to suture the rawed edge of the antihelix into an incision made just above the deformity and below the hairline When complete organization has taken place an incision is made as closely as possible to the hairline above and sufficient skin is mobilized in the form of a flap hinged upon the injured auricle adequate for the making of an antihelix If the flap is adequate in size so it can be folded upon itself in the direction of the head only the raw area remaining upon the latter need be split grafted Often it can be closed by a modified Z plasty Where this is not possible a Stent mold must be covered with a split graft and the ensemble insinuated between the elevated flap now attached to the auricle and the raw surface left by its creation on the head Upon the completion of the antihelix in this fashion a helix must be added according to one of the methods described under that heading

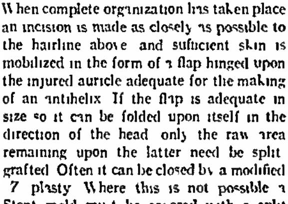


Fig 260 Cocheril procedure for reduction of an ear

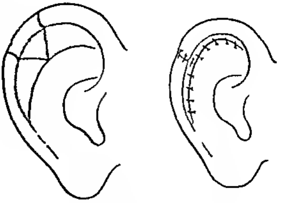


Fig 261 The Lexer procedure for the reduction of an ear

The method just described though relatively simple and in common use is seldom very satisfactory A more satisfactory procedure is to make a long cervical tube which is then waltzed into position just above the injured auricle and more specifically to a point originally occupied by the root of the helix After three or four weeks a segment of the tube consistent with the horizontal diameter of the antihelix is opened and sutured into its rawed edge After the lapse of another two or three weeks this same process is reversed in the direction of the root of the helix and sutured to the originally implanted pedicle of the tube This forms a segment of the original cervical tube doubled upon itself in the region of the superior pole of the injured ear When this step has been completed and healing has taken place the cervical peduncle of the original tube is migrated to the region of the lobe of the ear thus subserving both the construction of a helix and an antihelix (Fig 258) When the tube has attained circulatory integrity the remainder of it is opened and sutured about the now more or less reconstructed auricle to act the part of the helix This results in a double fold or to put it another way two layers of the original cervical tube in the region of the superior pole The appearance is similar to that of two convolutions The

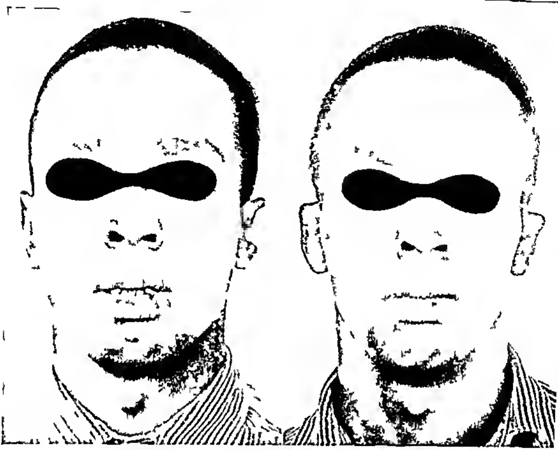


FIG 262 One stage reconstruction of ear deformity due to loss of helix and antihelix (*Left*) Preoperative condition (*Right*) Postoperative condition This was accomplished by reduction of size of right ear and transfer of excised segment to injured ear as composite free graft (Reduction of angle of helicine root may be indicated)

skin between these convolutions is then excised and the segments of the tube are sutured together so that they constitute a *concave representation of the region of the antihelix* The outermost segment which is continuous with the tail of the tube last migrated to the ear is sutured so as to be representative of the helix There are several advantages to this method It can be *accomplished without any scarring whatsoever in the region of this mastoid* It is accomplished at a comparatively low tissue cost It is a simple method This method is particularly advantageous where the patient s *good ear* has a prominent *fossa* of the antihelix and consequently also an obvious crus By proper excision of the two segments of the folded tube a much better fossa can be created than by certain other means (Fig 259)

Where the antihelix of the normal ear is a more or less characterless flattened segment of the auricle a much less time consuming procedure can be carried out by the use of local flaps Two curved triangular flaps are made one in front of the injured ear and the other over the mastoid region points downward They are tunneled under the skin remaining between the two flaps and lying above the superior pole of the auricle They are guided into the tunnel one above the other by appropriately placed sutures in the tip of each flap so that when the sutures are crossed under the tun

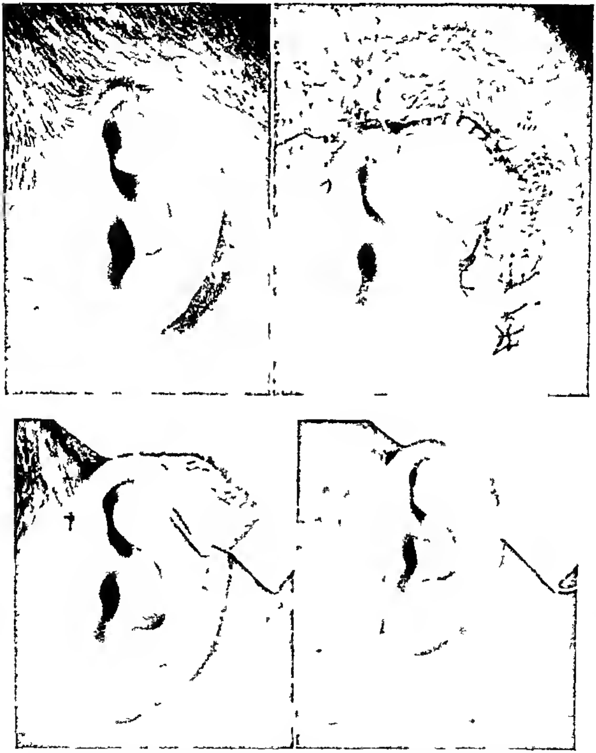


Fig 263 Combined reconstruction of scapha and helix (*Top left*) Defect of the auricle shown sutured into the mastoid skin (*Top right*) Ear is now freed with triangular flap of mastoid skin left attached and doubled on itself Mastoid defect is shown closed by direct approximation (*Bottom left*) The flap is shown with sutures removed and ready for reduction and insertion of cartilage (*Bottom right*) Final result with cartilage inserted

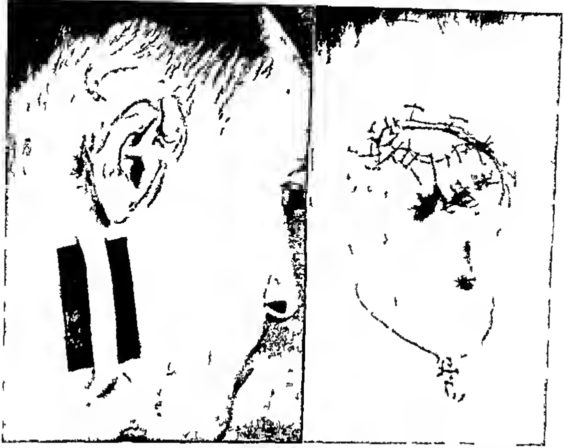


FIG 264A Total reconstruction of scapha and helix (*Right*) Excision of all contractile scar tissue in region of superior pole shifting of antihelix and remains of scaphal cartilage posteriorly with attachment to posterior tunnel flap Latter is shown partially avulsed so as to accommodate shifted antihelix and supply tissue for scapha Infra auricular suture line indicates coincident approach to base of concha which also had to be shifted posteriorly and reimbedded in order to permit adequate rotation of contracted ear (*Left*) Formation of pre auricular and postauricular tunnel flaps according to author s method These are destined to supply crus of helix and fossa of helix with scapha Note infra auricular tube intended for helix With freeing of superior pole cervical tube can be brought up to form helix

neled skin and brought out superiorly the flaps are more or less crossed thus forming a lining under the bridge of skin remaining above the injured ear The donor sites always can be closed by undermining and direct approximation When this lined ensemble of skin is healed its fower edges are incised and sutured to the rawed injured portion of the auricle At the same time a thin piece of cartilage may be inserted into the lined flap and sutured to the cartilage of the ear After the lapse of three or four weeks the skin of the hairline is incised and the entire appendage is freed from the side of the head The small granulating area on the latter can be free grafted if necessary The ear is then ready to receive that portion of the missing helix surrounding the antihelix This can be added onto the reconstructed antihelix by one of the methods described above under the heading Helix

Fig 264B Total reconstruction of scapha and helix (*Continued*) (*Right*) Posterior aspect of reconstructed right ear showing adequate cephalo auricular angle This is a cardinal test for a well positioned and reconstructed ear (*Left*) Upper pole of ear shown ready for complete avulsion with cervical tube brought up into position for approximation to avulsed ear Note that one peduncle of cervical tube has been migrated into infra auricular incision to avoid additional scarring The same peduncle will be migrated to completed root to form helix

Under certain conditions and in particular circumstances a one stage reconstruction of a missing antihelix and helix may be done One of the prerequisites to this is that the normal ear be sufficient in size to tolerate reduction In this special circumstance the defective ear is prepared by rawing of the edges of the defect and whatever small excisions are necessary so that the extremities of the defect can be brought together When the reconstruction is completed segments are removed from the normal ear so as to reduce it to the size of the reconstructed ear This can be accomplished by several standard procedures most of which are based upon the original procedures of Cocheril (Fig 260) and Lexer (Fig 261) with a one stage result as indicated in Figure 262

Scapha Losses in connection with the scapha always involve at least deformity if not actual loss of the helix If the post auricular skin is not implicated it may be used in the reconstruction The defect is freshened and sutured into the skin overlying the mastoid (Fig 263) At the expiration of two weeks or more the ear is mobilized with a triangular flap of mastoid skin left attached to it This is then folded on itself in an anterior and superior direction so as to form a double layer pouch of tissue as illustrated The defect over the mastoid is closed by direct approximation after undermining After the lapse of another three or four weeks the folded tissue flap at the top of the ear is then reopened most of its fatty tissue is removed and a strip of cartilage is inserted to form the convexity of the helix The cartilage is taken from the normal ear

In certain instances particularly in burns scaphal voids may be complete In

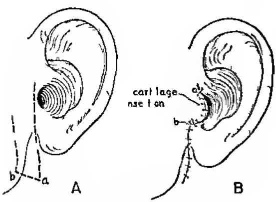


FIG 265 A method for construction of tragus from rotated preauricular flap Cartilaginous support to be taken from back of concha

such cases the use of one mastoid flap is inadequate in the reconstruction In such instances the correction may be made by the use of two flaps—one preauricular and the other postauricular—which are tunneled above the ear and under the skin of the scalp as described in the author s procedure mentioned heretofore This almost *invariably necessitates additional tissue in* the form of a cervical tube (Fig 264) The contracted portion of the scapha is then incised so that the antihelix can be brought back over the mastoid thus exposing the antihelicine fossa and is sutured to the extremity of the posterior flap This coincidently opens up the concha as illustrated Two or three weeks later the superior pole *of the future ear now comprised* by the two tunneled flaps is avulsed This creates a *cephalo auricular space behind the* ear so necessary to a well appearing reconstruction particularly when viewed from the rear The lower peduncle of the cervical tube is then waltzed up and around to the anterior underfolded flap which acts as the crus for the future helix Finally the other peduncle of the tube is waltzed and adjusted to the ear coincident with readjustment of the concha which in the case illustrated was drawn to the head by fibrous tissue back of the ear

Concha It is a rare injury to find only the conchal segment of the ear missing Whenever the concha is missing some other major segment of the ear is usually lacking Where such an exclusive injury does exist it is usually a major perforation of the auricle This type of defect is most expeditiously reconstructed by a posterior auricular flap which is folded upon itself and insinuated through the perforation to the anterior aspect of the auricle When complete organization of the flap has taken place its folded extremity can then be split and sutured into the denuded rim of the *antihelix and the region about the external* auditory meatus This type of repair as a rule is adequately sustained by the remaining cartilage of the auricle and seldom needs additional cartilage for its maintenance

The Tragus The simplest procedure for the construction of the tragus consists in the mobilization of an adequate flap anterior to the lobule which is then advanced upward folded upon itself and rotated across the *concha so as to form a very prominent nip*ple in that region The donor site is invariably closed by direct approximation After a period of from three to four weeks entry is made into the flap through the original suture line and a small piece of cartilage is inserted The soft tissues at the base of this suture line and anterior to the external auditory meatus should be dissected to the cartilage of the external auditory meatus The free graft of cartilage insinuated into the *new tragus must then be sutured to the* meatal cartilage in order to maintain position and direction of the tragus (see *a* and *b* in Fig 265)

External Auditory Canal and Meatus Where the middle ear is present and functioning there is a rational basis for the construction of an external auditory canal and meatus This is usually accomplished by relatively extensive excision of soft tissues in that region thus forming a surgical sinus of considerable extent In the prepa

ration of the canal there should be no fear of excising too much tissue The usual mistake leading to failure (postoperative atresia) is the excision of too little tissue Once an adequate sinus has been established it may be lined by a split skin graft wrapped about a Stent mold This is seldom a reliable procedure because the split graft has a pronounced tendency to shrink and eventually obliterate the new canal This can be avoided to a large degree through prolonged stretching of the new canal by packing with humid cotton The cotton must be changed every four or five days the inner fatty content of the tube turned outward This procedure carries with it a definite technical difficulty and that is the securing of the free end of the tube into the depths of the wound The same difficulty arises in connection with the Bouisson procedure which utilizes an inverted tubed flap taken from the postauricular area (Fig 251) This can best be accomplished by the use of an acutely curved Reverdin needle and the use of fine wire suture material The sutures are first passed through the end of the tube one at 6 and 12 o clock and the other at 3 and 9 o clock The Reverdin

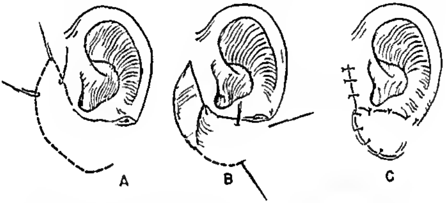


Fig 266 A method for total construction of a lobule by the use of a preauricular flap (A) Outline of flap (B) Inversion of flap (C) Closure (See Fig 267)

over a period of several months A more reliable and permanent reconstruction without the necessity for prolonged dilatation can be obtained by the use of a free full thickness graft When using full thickness skin it must be taken from a hairless area or the new canal may become filled with exuberant hair growth (Fig 250) Skin from the inner aspect of the arm is ideal

The most reliable method of constructing an external auditory canal is by the use of a small tube This may be made under the angle of the jaw or immediately in front of the ear At the time of its transfer into the surgical sinus the waltzed pedicle of the tube is reopened sutured into the sinus with the skin surface turned in and needle is passed through the depth of the surgical sinus and one end of the wire suture is insinuated into the opening in the Reverdin needle This is then withdrawn so that it presents somewhat to one side of the sinus The same procedure is repeated with the other three ends of the sutures The tube can thus be allocated in the depths of the sinus by pulling upon the wire sutures The suture end presenting at 12 o clock is then tied to the suture end presenting at 3 o clock and the suture presenting at 6 o clock is tied to the one presenting at 9 o clock That portion of the tube adjacent to and on a level with the external circumference of the surgical sinus is then approximated by a few fine plain or chromic gut

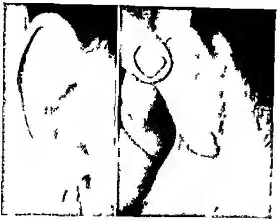


FIG 267 Illustrating preoperative and postoperative condition in reconstruction of auricular lobule according to method shown in Figure 266 (Delay of flap is sometimes necessary)

sutures When adequate healing has taken place after about two weeks the tube is divided about one quarter of an inch above the level of the concha and is properly trimmed Its internal skin edge is approximated to the skin of the concha and the medial rim of the tragus (Fig 252)

Lobule The simplest method of reconstruction of the lobule in the hands of the neophyte is that relying upon the use of a small tubed pedicle usually taken from the region posterior to the angle of the mandible The tube is waltzed into position until it is in the form of a small loop or a U The two extremities of the loop after circulation is adequate are incised and approximated so that their fusion resembles a lobule

I prefer a preauricular flap as shown in Figure 266 Other adequate methods are those of Nelaton Dieffenbach and Gavell (Fig 268)

DERANGEMENTS

The ear like the nose being a protruding freely mobile appendage may suffer derangements on a segmental rather than a general basis more frequently than other anatomic parts which are more integrally a part of a larger whole In other words distortions displacements and misplacements of the auricular appendage may more easily be visualized as segmental or general apropos the subdivision of voids into partial and total

SEGMENTAL

Segmental distortions displacements or misplacements of the auricle may be either congenital or acquired The congenital types of derangements are more often than not looked upon as individual characteristics in a patient These congenital individual characteristics of the auricle are such a prominent part of the physiognomy of the individual and their variations are so manifold that they may be likened to the finger prints In fact the French Surete capitalizes on this consistent variation in human ears by employing it in the identification of individuals parallel with the use of the finger prints With detailed study of the anatomy of the auricle this becomes quite evident and the surgeon is often able to identify his patients by means of the ear in the same way that the roentgenologist often recognizes the identity of a patient by a roentgenogram of his chest pelvis, or knee joint

The correction of these characteristic congenital disproportions affecting individual auricular segments is usually of no practical consequence unless the variation, as compared with the rest of the ear is of such extent that it is too obvious For instance the lobe may be so small that it is almost entirely absent or the antihelix may be so flat as to be all fossa and no crus The helix may be so prominent in one part as obviously to distort the whole or the tragus may be so large as to appear like a separate segment or appendage of the auricle In such instances a revision of the segment is indicated

The acquired derangements of the auricle consist for the most part of scars pigmentations and other defacements If these occur on the back of the auricle they can almost always be excised and the surgical defect closed by direct approximation If they

occur on the front of the ear where the skin is thin tight and closely adherent to the underlying cartilage the defect after being excised must be replaced by a split graft unless the size of the affected segment is such as to permit excision of some of the underlying cartilage according to geometric plan thus permitting closure of the defect by direct approximation of the cartilage and skin

The most common segmental derangements of the ear aside from the primary lop ear are affections of the lobe These consist of clefts derangements of size position angle of incidence to the rest of the auricle or the head or fusion with the skin of the face The correction of such derangements is always a matter of geometric shifting of small flaps whose exchange establishes the desired form or position of the lobule (Figs 269 and 270)

Lop Ear (Primary) A common derangement of the auricle consists of the so-called lop ear A lop ear which belongs in the category of auricular derangements is of a specific type in contrast with one which is primarily a case of macrotia and whose lop is more apparent than real The latter should be classed under Excesses — (Macrotia) The true or primary lop ear is one where the relationship of the various segments of the ear—particularly their size —is within normal limits but the ear as a whole has a large scaphoconchal angle It is not due to an unusually large concha or a generally large ear but is a very thin ear with inadequate timbre of cartilage and lack of antihelix with a flaring fossa This type of lop ear is not unusual and its correction is quite simple This correction consists of a simple excision of an elliptical area of skin on the posterior aspect of the ear double incision of the antihelicine cartilage in the polarity of the normal crus external eversion of the incision under the mobilized central bar of cartilage and over correction by a second approximation over the central bar (Fig 256) Final narrowing of the scaphoconchal angle is by direct approximation of the surgical wound Before closure of the skin the conchal cartilage may be more securely approximated to the fascia overlying the mastoid region for purposes of overcorrection This procedure must not be used on the type of lop ear which will be discussed under Excesses and classified as a secondary lop ear

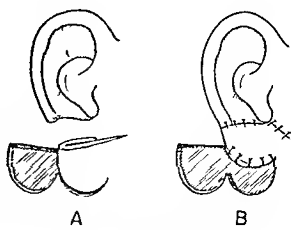


Fig 268 Gavello procedure for total reconstruction of lobule

W G McEvitt has presented a scholarly treatise on lop ears in the September 1947 issue of the Journal of American Society of Plastic and Reconstructive Surgery He divides them into three types all of which nevertheless have one thing in common—the maldeveloped antihelix He proposes a procedure which attacks the true lop ear on this basis directly and exclusively McEvitt s procedure is basically correct but tends to leave an antihelix sharper than normal with an occasional skin fold anteriorly which may remain permanently The maintenance of the cartilage bar between two incisions and the double row of sutures (author s practice) between fossa and concha eliminates this esthetic detail and ultimately results in a firmer antihelix Excision of cartilage in a true lop ear is a rare necessity except for a small wedge in the region of the antitragus

General

Cauliflower Ear The cauliflower ear is essentially a derangement of the cartilagi

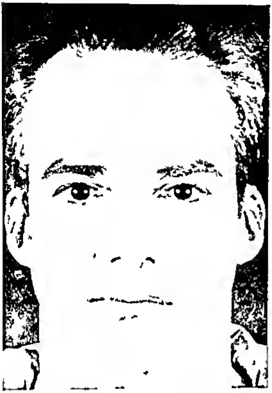


Fig 269 Congenital deformity of ears Note excessive prominence of anti helix its separated crus pronounced depth and malformation of concha deformed antitragus pleated lobule with relatively normal helix and fossa of the helix Conditions such as these necessitate complete separation of all major segments of the auricle and their individual shaping and reconstitution No set or prescribed plan of procedure is possible

nous supporting structure of the appendage The auricular cartilage has many rather large perforating arteries whose walls are closely adherent to the surrounding cartilaginous framework The resiliency of the framework is of a far greater degree than the elasticity of the arterial walls Consequently when severe trauma is inflicted upon the auricle, although the cartilage may escape without actual fracture the arterial wall is torn loose, or more often the artery is actually lacerated as it passes through the cartilage Profuse subperichondrial hemorrhage results If the perichondrium is torn, as it often is the hemorrhage will extend under the skin With the organization of the clot and separation of the perichondrium from the cartilage, the latter in due course of time will warp The organized blood clot remains as a hard elevation under the skin The ultimate result is a deformity of the entire auricle

The avoidance of a cauliflower ear resides in the early evacuation of the clot by means of a buttonhole incision and the application of a pressure dressing over the affected part or the entire auricle

The reconstruction of an old cauliflower ear is based upon the total excision of all scar tissue under the skin, which sometimes demands excision of some of the skin overlying the organized hematoma This will usually reveal a warped, fibrosed cartilage underneath which must be recarved or whose warped condition may be remedied by crosshatching or partial excisions The entire ear should then be splinted in the same manner as an acutely burnt ear namely, by accurate packing of humid cotton into all the curvatures and recesses of the newly reconstituted auricle This splinting must be maintained for a relatively long period of time a minimum of 19 days because the warped cartilage has a tendency to resist repositioning

Deformities Deformities are extreme derangements of the auricle which may be either congenital or acquired (see 'Cauliflower Ear) Strictly speaking they apply to ears whose over all dimensions are within the normal but the relation of whose segments and their individual forms is outside of the normal These derangements and irrelationships more severely affect the upper half of the ear than its lower counterpart They are usually marked by a prominence of the crus of the antihelix (in contrast with the lop ear) a small fossa of the antihelix, a restricted helix and a crowded concha (Fig 270) The ear in general appears as though its various segments were

pushed or crowded down on the side of the head

The reconstruction of an ear so deformed necessitates as much ingenuity as the total construction of an auricle No rigid manner of procedure or blueprint for such reconstruction can be laid down because every auricle is a problem in itself In general, the individual problems presented by this type of ear are the revision of the root of the helix, enlarging of the scapha and antihelicine fossa, reduction of the prominence of the antihelix, revision of the helix and, in general, increasing the height and the prominence of the superior pole of the auricle It is always a problem for the experienced plastic surgeon (Fig 271) It is best accomplished in one surgical inning

Miscellaneous Many more derangements of the auricle occur in connection with hemangiomas, epithelioma, lupus, dermoid cysts and naevi These conditions usually command partial or total excision of either the soft tissue covering of the auricle or some or all of its cartilaginous framework, thus resulting in surgical voids which must then be reconstructed in accordance with the principles laid down under relevant otoplasties above

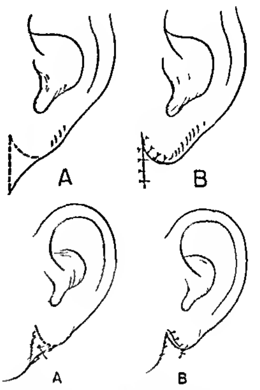


Fig 270 Methods of freeing ear lobule (*Top*) Conventional method of web excision and closure (*Bottom*) A method of separation by web splitting procedure (Pick) This obviates visible suture line below the ear

EXCESSES

True

Lop Ears (Secondary) Although an otherwise normally formed auricle can be so placed on the side of the head as to have an unusually large cephalo auricular space (see under 'Derangements') in actual practice the secondary or false lop ear will be found marked by a prominently augmented superior pole, it will have an excess of both skin and cartilaginous support, an augmented cephalo auricular space and coincident absence of normal relationship of parts It may or may not have an unusually flat antihelix, a flaring fossa of the antihelix, a prominent helix with a wide fossa, and a deep concha with a thick cartilaginous floor It is a basically and intrinsically unbalanced or deformed ear (Fig 272) in contrast with a true macrotia, which is a balanced but totally exaggerated auricle *Hence the commonly encountered* simple descriptions of the operation for correction of a lop ear prove to be inadequate to meet the problem of the secondary or false lop ear whose superior pole is exaggerated and so gives the appearance of an ear protruding from the side of the head The simple incision excision or multiple incision of the conchal cartilage on its posterior cephalo auricular aspect and cephalad apposition cannot correct the condition fully

The false lop ear demands calculated excisions of the antihelix, concha, antitragus, and the skin, both over the posterior as well as the anterior aspect of the ear

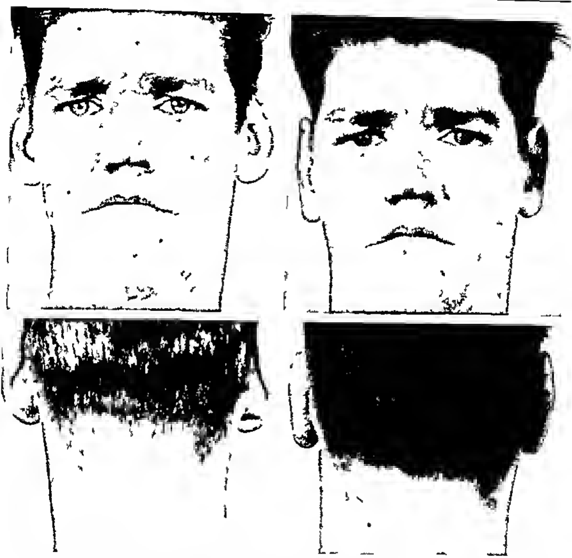


FIG 271 (*Top left*) Preoperative condition of "upside down" ears A complete inversion and dystocia of the ears (*Top right*) Postoperative reconstruction (*Bottom left*) Preoperative posterior view of "upside down" ears (*Bottom right*) Postoperative posterior view Cartilage extended throughout ear Appropriate sections were removed inferiorly and transplanted into augmented upper poles

The excisions must be volumetrically accurate and geometrically precise in order that the formative restorations of such an ear result both in normal appearance of the individual auricle as well as bilateral symmetry and likeness Since the amount of the various segments on the two sides usually varies it is necessary to identify the geometric differences between the two ears prior to operation so that the mistake is not made of excising the same amount of cartilage on the two sides and so end up with two ears which look fairly normal individually but do not resemble each other in details The proper reconstitution of this type of ear is actually a combination of many more or less standard procedures applied to individual segments or parts of the auricle

FIG 272 Excessive segmental development of the ear (*Top, left*) Overdevelopment of scapha with pronounced Darwin's tubercle and dystocia of helix (*Top, right*) Post operative (*Bottom, left*) Posterior view preoperative (*Bottom, right*) Posterior view, postoperative (Unevenness of tail of left helix due to abrasion after healing)

The basic plan of reconstruction of this type of ear resolves itself into three parts (1) the reduction of the great flare of the helix, including the fossa of the antihelix, (2) the reduction of the horizontal dimension of the concha posteriorly, and (3) reconstruction of the antihelix The basic procedures upon which this is accomplished are the Luckett, Monks, New and McEvitt operations and also their numerous variations

One thing that the student should bear in mind in connection with otoplasties is that they must be done on strictly individual geometric premise To do otherwise is to substitute a surgical monstrosity for a deformity

A macrotia, strictly speaking signifies a generally large ear over all, which is in itself symmetric but out of proportion to the head Such an auricle is less common than any "lop ear" It is much less common than the simple lop ear with its increased scaphoconchal flare Whereas a true lop ear is essentially obvious in the anteroposterior view, the true condition of macrotia is more conspicuous in profile This is due to the fact that the ear in macrotia is out of pro

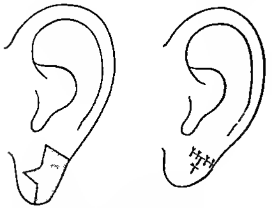


FIG 273 Joseph procedure for reduction of magalolobule Shaded area represents type of excision

portion to the size of the head rather than out of position as concerns the head Whereas in the lop ears the basic considerations are the reduction of the scaphoconchal angle the creation of an antihelix and only a minor reduction of one of the tangent segments of the ear cartilage in macrotia on the other hand all segments of the ear have to be reduced to conform to a predetermined over all dimension of the ear as compared with the size of the head This is accomplished and based on the original operations of Morestin Cocheril Lexer and their variations (Figs 256 260 and 261) and that of Joseph as concerns the lobule (Fig 273) It is a task almost equal to a total otoplasty necessitating experience sense of symmetry and appreciation of detail Both should be done at the same sitting

Congenital Rests Since the embryologic genesis of the auricle is based on six separate loci misplacement or lack of proper incorporation and fusion of these into the adult auricle is not rare Extraneous appendages many of them containing bits of cartilage may be found usually anterior to the auricle or below the lobule These tissue excesses as a rule need nothing more than simple excision provided they do not involve the auricle proper In the latter case some minor degree of reconstruction of one of the segments of an otherwise well formed appendage may be indicated The only detail of surgical consequence in this connection is that the excision be planned so that it conforms with Langer s lines of tension on the one hand and not interfere with the integrity or the position of the auricle on the other

FALSE

The neoplasms affecting the auricular appendage are mainly pathologies of the cutaneous vascular and cartilaginous type They may be malignant or benign The benign neoplasms of the skin usually affect the postauricular covering in contrast with the malignant type which usually affect the skin on the front of the ear The former involve only simple excision and closure by direct approximation whereas the latter usually imply full thickness excision including the cartilage This denotes major reconstruction of the auricle Consequently when excisions are made they should not only be consistent with the nature of the pathology but should be planned so that the surgical defect will if at all possible leave the auricle subject to reconstruction This of course is out of the question where all or the major portion of the auricle has to be sacrificed In such instances one has to face the prospect of a total otoplasty This can almost always be avoided by early and intelligent biopsy excision of the offending lesion

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28

The Upper Extremity

GENERAL

Akin to the impetus given the modern development of maxillofacial surgery by World War I is the development of reconstructive surgery of the extremities in World War II. The thesis that extent of bone involvement determines the severity of an *injury to an extremity was the premise of* judgment in the management of such defects in the past. This was reversed to a large degree in World War II through the work and the efforts of the plastic surgeon in establishing the important relationship of soft tissues to the functional integrity and ultimate rehabilitation of the extremities.

The orthopedic surgeon soon became aware of the partiality of the original thesis and realized that no amount of orthopedic management or manipulation was equal to the problems involved in such war injuries. Soft tissue repair took precedence over strictly orthopedic management. Thus the plastic surgeon in co-operation with the neurosurgeon and the orthopedist placed the management of such extensive injuries upon a more physiologic basis. This consisted in early free grafting of open wounds to expedite closure, avoidance of secondary infection and conserving the integrity of tissues collateral to the injury, early ambulation and physiotherapeutic treatment of the collateral tissues to expedite return of circulation and lymphatic integrity, and finally the mobilization of adequate masses of soft tissue for purposes of augmented and more reliable bone grafting. A wide field of usefulness was thus found for the *application of the principles of plastic surgery* to orthopedics in World War II not dissimilar from the contributions made to maxillofacial surgery in World War I. The ultimate consequences of the integration of the plastic surgeon's work in the prospectus of Military Surgery were fewer amputations, earlier ambulation, less invalidism and more telling rehabilitation of not only the vital extremity but the individual as a whole. The age-old trial of Military Surgery, namely control of hemorrhage, prevention of infection and treatment of shock, had thus been augmented to include the fourth and functional factor of rehabilitation and that is reconstruction. *This applies as well to civilian practice.*

To quote Harold A. Sofield:

> The gravest error that our generation can make in regard to advancement in fracture treatment is to neglect the lessons to be learned from experiences of the recent world conflict. Experience gained from a study of these cases shows that fracture books written before the war are now sadly in need of revision. Methods of fracture care which seemed adequate in the experience of 20-50 cases frequently are found wanting when analyzed in a series of 1,000 or more cases, and it is only by analysis of large groups of these cases that significant observations can be made.*

What Sofield has to say about the treatment of fractures applies in fact to the management of extensive injuries of the extremities in general. The orthopedic surgeon who has served in World War II has not served himself well if he has missed the opportunity to acquire knowledge of the basic principles of plastic surgery and their

* H. A. Sofield: Observations on fracture treatment, Illinois M. J. 92: 346, 1947.

application to compound injuries of the extremities

VOIDS

Total voids of the upper extremity are obviously of no practical importance to the plastic surgeon. Transplantation of an entire extremity, although accomplished in animals as illustrated by the work of Alexis Carrel, Lexer, Tuffier and others, is not feasible in the human. Such surgical substitution for the present, at least, must be resolved in terms of the inanimate prosthesis. Of the latter there are two types—the mechanical and the cineplastic prosthesis.

CINEPLASTY

Where the function and the appearance of the arm is so hopelessly involved either by contracture, disease or neoplasm that reconstruction is impractical or obviously out of the question, amputation of the appendage may have to be accepted. The loss of an arm is a most serious problem both from the esthetic viewpoint as well as from the functional standpoint. This is most certainly true where a bilateral amputation must be performed. A blind man can "see" his way about the world with his hands. Few forms of invalidism can compare with the combined loss of both eyes and both arms or hands.

The usual problem fortunately is the one where an individual, otherwise in good health, has to give up only one arm. An occasional patient is able to meet the demands of life quite successfully with one hand, but for the most part the amputee becomes at least a psychological problem for esthetic reasons if not for an economic one unless some type of substitute replaces the lost appendage. The esthetic value of the arm in our society is almost as important as its functional worth. In fact, even among those essentially interested in the question of prosthesis there is still considerable controversy as to which is of greater import—appearance or utility. The proponents of the Hook appliance take the position that the patient's interests, from an emotional standpoint, are best served by that which gives him greatest utility—and that is the Hook. The opponents of this perspective take the position that the so called mechanical arm, even though less effective from the utilitarian standpoint, contributes much more to the patient's happiness from the outset and that this element in itself compensates for the relatively lesser mechanical utility of that type of prosthesis.

Kessler takes the pragmatic middle road and advises the application of critical judgment, individualization in patients and selectivity of prosthesis based upon the patient's psychological peculiarities as well as the multiplicity of demands which may exist as a result of the individual's vocations, hobbies and other aspirations. He states the case as follows:

> The choice of the prosthesis is made after the factors of utility and appearance are weighed in the light of the patient's personality and the social and industrial problem he must face. A compromise may be made by providing an interchangeable esthetic hand and a work arm (or hook). An ideal cannot always be realized. What is important is to make available to the amputee a wide variety of services so that his specific needs may be met.*

From a utility standpoint the prosthesis *must subserve three basic functions: that of* the hook, the plier and the forcep. Esthetically, the prosthesis must fill the void in the sleeve, be as good a mimicry of the normal hand as possible and subserve as much of the basic function of the upper appendage as can be incorporated within the substitute. The former is best represented by the so-called utility hook. This is a split or double hook mechanism which remains closed by virtue of a wide rubber band at its base and can be opened by any force which pulls one of the arms of the hook against the tension of the rubber band.

* Kessler, H. H.: Cineplasty. Springfield, Ill., Thomas, 1947.

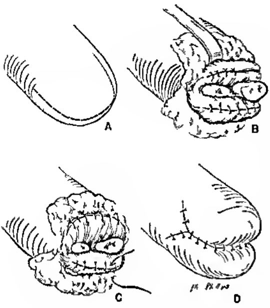


Fig 274 Types of cineplastic motors (Kessler) (A) Bisection of stump with the formation of flexor and extensor flaps of skin and subcutaneous tissue (B) The flexor and extensor muscles are sutured separately in the form of a stump (C) The ulna and radius are then amputated one or more inches proximal to the end of the muscle stumps (D) The skin flaps are sutured back so as to form a cleavage groove between the flexor and extensor muscle groups (Kessler Cineplasty Springfield Ill Thomas)

The latter is accomplished by the deliberate forward rotation of both shoulders which are encircled by a lanyard this force is transferred to the appliance thus opening the split hook The same principle is applied to the artificial hand which is the closest mimicry available to the normal appendage yet devised

Cineplastic Surgery

The principle of the cineplasty resides in the utilization of the muscle power remaining after loss or amputation of an extremity and the transfer of this function to a prosthetic appliance by means of so called motorization or cinematization of the stump The success of the operation depends upon the quantitative substance and integrity of the muscles remaining after amputation and the qualitative timber of the reconstructed stump or point of cinematization

The work that a muscle can perform is dependent upon the quantity present the quality of its contractility and the direction of its pull The amplitude of performance of a muscle can be determined according to *the formula* $W = F \times D$ where W represents work F represents force and D represents the distance over which the muscle travels or the amplitude of its contraction The latter has been quite accurately determined by Bunnell on fresh cadavers apropos the upper extremity

Cinematization can be accomplished in three ways by the construction of the club motor the loop motor or the intramuscular canal

The club motor is a kind of modified Krunkenberg operation It consists of the

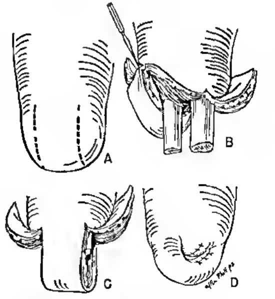


Fig 275 The loop motor (A) Incisions are made to form 2 external cutaneous flaps with a hammock flap in the center (B) The stumps of the ulna and radius are amputated (C and D) The lateral flaps are then sutured under the hammock flap which is tubed (Kessler, Cineplasty Thomas)

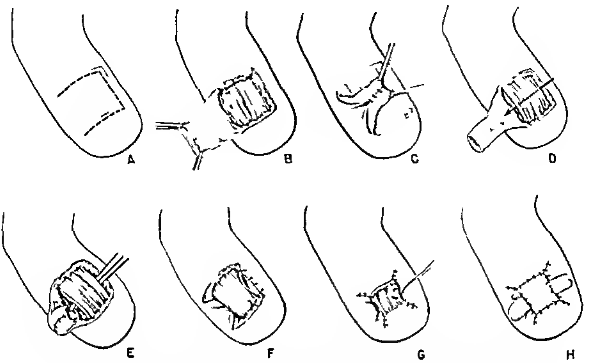


Fig 276 The canalized motor (A) Skin subcutaneous fat flap outlined (B) Flap everted (C) Flap tubed, rawside out (D) Muscle split (E) Tubed flap being pulled into corners (H) Free graft coverage of residual defect Canalization completed (Kessler Cineplasty, Thomas)

reflection of the extensor and the flexor muscles of the appendage, which are then kept separated by coverage with skin flaps lined with adequate subcutaneous fat After resection of the protruding bone ends a circular depression remains about the end of the stump in the form of a bracelet, to which the prosthesis may be applied by means of rings (Fig 274)

The aim in the construction of the loop motor resides in the making of a tubed pedicle ('satchel handle') over the end of the stump by appropriate flapping of its tissues One peduncle of the tube thus transmits the flexor force and the other the extensor force upon the prosthesis, which is attached through the space between the tube and the end of the reconstructed stump (Fig 275)

The principle of cinematization via the intramuscular canal depends upon the construction of the latter in the termini of selected muscles which may then be used as points of attachment and insertion of the movable extensions of the prosthesis (Fig 276) In the creation of these canals through the selected muscles the same principles of plastic surgery apply as in the making of a tubed pedicle From a practical standpoint, the important thing for the student to remember is that these canals never should be too long or too narrow The shorter and wider they are, the more efficient they will be and the less trauma to the lining of the canal that will result from the insertion of the pegs of the prosthesis

This surgical projection of muscle power into the mechanical possibilities of an inanimate substitute for the loss of an appendage is the nearest that surgery has been able to approach the communion of residual anatomic force and the possibilities inherent in mechanical contrivances As with any other surgical procedure or concept, it must be made to fit the individual case, otherwise its rampant routine application will

result in a high percentage of disappointments and failures

The selection of the patient appropriate for cinematization depends upon a number of factors, all of which must be taken into consideration Some of these are the length of the stump, the quantity and the integrity of muscle tissue present, the ability of the surgeon, the intellect of the patient, along with his environment, his temperament and the nature of the work which will be his source of income Finally, the prosthesis applicable to cinematized stumps must be especially constructed to fit each case Standardization in this type of prosthesis is possible to a lesser degree than with the conventional form of appliance

According to Bergmann it is desirable to have flexor and extensor canals (double motor), because of their valuable antagonistic action Both can be made in one sitting If the local conditions of the stump forbid the forming of a double motor, one might, with some prospect of success create the flexor canal alone and dispense with the antagonistic action, but where one cannot have a flexor canal, it is not worth while to form the extensor canal bone "*

DERANGEMENTS

Although the problem of over all derangement of the upper extremity exists, particularly in extensive third degree burns, for practical reasons it is best discussed in terms of derangements of the various segments of the upper extremity This will be found under the subsections shoulder, arm, forearm hand, etc

EXCESSES

What has been said in connection with derangements of the upper extremity as a whole applies even more so to the question of tissue excesses, with the possible exception of generalized postoperative edema of the upper extremity Since this latter condition is of essentially general surgical interest rather than reconstructive, the student is referred to textbooks on general surgery for its treatment

Generalized Edema The method of Beck is a simple and fairly efficient approach to the resolution of generalized postoperative edema of the upper extremity This consists of the insertion of strips of celloidin, about 1 x 12 inches through buttonholes in the skin around the axillary region The subcutaneous tissue is tunneled in the anterior axillary fold from arm to pectoral region and in the posterior axillary fold from arm to scapular region, the celloidin strips are completely buried in these tunnels for a period up to 19 days The incisions on the arm are then reopened, and the celloidin strips are removed Usually, considerable improvement will be found in the upper extremity at the time of removal of the celloidin strips

The validity of the foregoing procedure is based upon the establishment of lymphatic communication between the arm and the pectoral and scapular lymphatics [In view of the orthopedic import of the upper extremity, it is deemed practical to discuss the various surgical differentials (voids, derangements, and excesses) under respective segmental headings]

SHOULDER

Voids The most common voids of the shoulder which come to the attention of the plastic surgeon are either the acute type, consisting of extensive avulsion of the skin and the subcutaneous tissue with a degree of injury of the deltoid muscle or the more extensive losses of soft tissue with involvement of the shoulder joint and the upper extremity of the humerus The latter is usually the type seen in association with war injuries

The first type of void, if clean is best repaired by resuturing of the insertion of the deltoid and coverage by flaps of skin and subcutaneous tissue whose donor site is

* E Bergmann Principles of cineplastic operations J Internat Coll Surgeons 9 100 1946

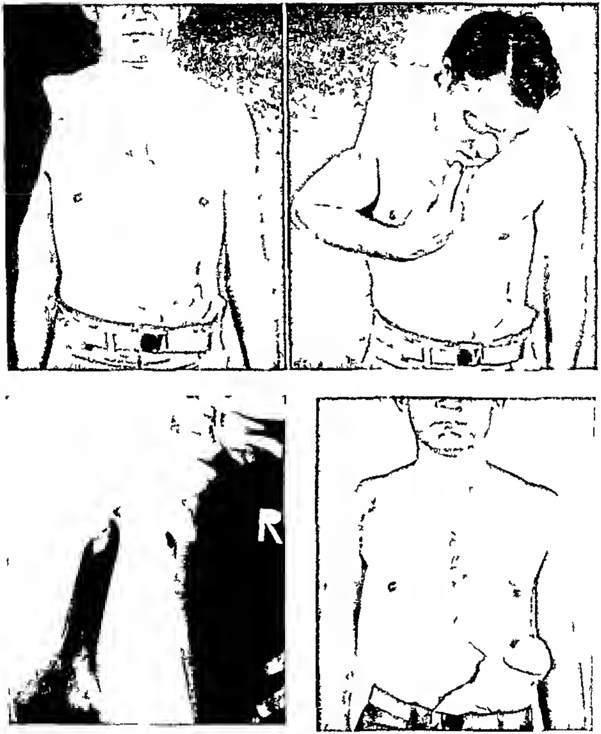


Fig 277A (*Top, left*) Extraordinary gross injury of right shoulder and upper arm the result of a gunshot wound (The tube on left side of abdomen bears no relation to contemplated repair of shoulder) (*Top, right*) Amount of action of upper extremity possible before reconstruction (*Bottom, left*) X ray showing extent of bony implications Dark spots are steel particles the remains of explosive agent responsible for injury (*Bottom, right*) Condition of extremity following complete soft tissue repair, including resuturing of muscles about shoulder To accomplish latter it was necessary to foreshorten the arm as illustrated Patient is still in need of bone graft to establish communion between remains of humerus and shoulder joint Soft tissue depression in subacromial region the result of mobilizing large pectoral flap

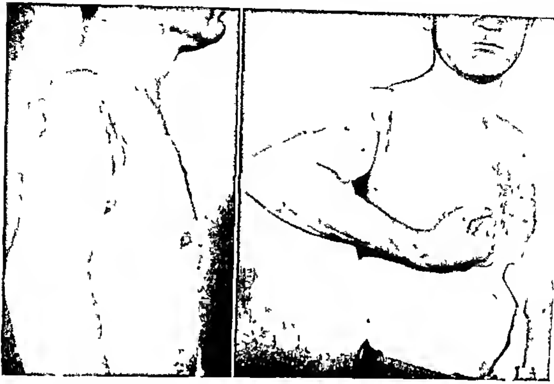


FIG 277B (*Continued*) (*Left*) Details of skin closure by rotating pectoral flap over acromion process which was joined to a flap from scapular region and another from the brachium itself Note that wedging of flaps into each other was accomplished so that suture line would not rest over bony prominences of shoulder (*Right*) Power of flexion and abduction of upper arm following soft tissue repair

the scapular region Where this cannot be risked, it is best to cover the raw area with a split skin graft until such time as the former procedure can be carried out In any case the deltoid muscle should be resutured at the first opportunity The important thing to remember is that a repair of the shoulder is never entirely satisfactory unless it can be done with collateral tissues Such repair as is dependent upon free skin grafts does not result in a good load carrying part, whereas that dependent upon the importation of tissue from other parts of the body is comparatively time consuming and, as mentioned heretofore, usually is not necessary, because the scapular region has an adequate source of material for reconstruction

Voids resulting from warfare are usually quite extensive and almost invariably involve the deeper structures, including the shoulder joint and some part of the humerus It is amazing, at times, how much of the shoulder may be missing and how much functional service of the upper extremity may be retained (Fig 277)

The first stage in the reconstruction concerns itself entirely with the soft tissues The old scars must be completely excised and all muscle and tendon tissue available located and resutured into as normal a structural position as possible This usually results in an amazing functional improvement Only after complete organization of the soft tissue repair should bone be grafted into the void Where the loss does not involve more than the anatomic head of the humerus, it is usually better to round

off the latter or even shorten the upper arm somewhat and to do a meticulous and accurate repair of the soft tissues this results in a very serviceable appendage provided that there is no nerve injury Where the bone loss involves a third or more of the humerus some type of bone graft must be plete scar eradication and repair by collateral flaps wherever possible

A likely coincident finding or complication of such shoulder injuries may be the disruption of the circumflex nerve Deltoid paralysis is the result Substitution of the paralyzed deltoid by the biceps the triceps

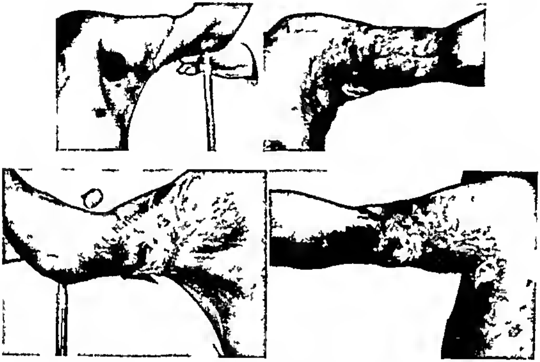


FIG 278 Extensive axillary webbing the result of third degree burn in infancy (*Top left*) Note complete anterior rotation of axilla with detectable evidence of axillary contents particularly the artery and vein (*Top right*) Anterior view of reconstruction of axilla by splitting of web and crossing the 2 flaps This necessitated careful dissection of axillary contents and advancing the latter into dome of axilla (*Bottom left*) Posterior view of web The light area is the result of scarring due to constant tugging and occasional breaking down of skin (*Bottom right*) Posterior view of repair Light areas are due to scar tissue used in repair There was no break down of the latter

inserted For this purpose there may be no better substitute than one of the fibulae In this connection the student is directed to appropriate texts on orthopedics

Derangements The soft tissue derangements of the shoulder most often encountered are those associated with gunshot wounds lacerations and scar formation usually following extensive third degree burns Therapeutically these imply com or the trapezius never has been satisfactory The arthrodesis of Albert is a more dependable procedure It consists of surgical fusion between the humerus and the acromial extremity of the scapula Following adequate fusion with the arm splinted in salute elevation the muscles of the scapula will move the upper arm to a fair degree

One of the rarest and most interesting congenital tissue derangements involving

the shoulder to a certain degree is the so called Klippel Feil syndrome (See Chap 35 Neck)

Excesses The outstanding true tissue excess involving the shoulder is the cervico brachial web This may be corrected by splitting of the web augmenting this in cision into a Z by the addition of two short incisions one at each extremity of the first at a 50° to 60° angle trans posing the triangular flaps thus formed in suchwise that the normal contour of the neck is re-established The *false* soft tissue excesses encountered about the shoulder are keloids lipomas fatty cushions and neoplasms of the bone Complete excision of the offending tissue is necessary Ade quate undermining of the tissues about the shoulder follows with designing of flaps suchwise that closure avoids suture lines over the shoulder joint

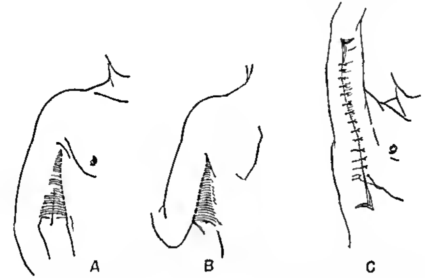


FIG 279 Manner of correction of short axillary webs (A) Splitting of web with anterior incision adjacent to chest wall (B) Mobilization of posterior flap by parabrachial incision (C) Correction by proper shifting of flaps

AXILLA

Voids Total axillary voids without ex tensive loss of the shoulder joint or serious trauma to the blood vessels of the upper extremity are rare Such an injury usually precludes reconstruction and leads to ampu tation Partial voids are quite common par ticularly in warfare Where the axillary void involves only the skin and the sub cutaneous tissue this can be repaired by a thick free split skin graft which must be kept molded into the depths of the axillary space by a large sponge or mechanic s waste with the upper arm abducted at more than 90° away from the torso Where the large axillary vessels and the brachial plexus are exposed it may be risky to cover them with a split graft except as a form of tem porary biologic dressing This dressing should then be replaced by a pedicle flap rotated into the axilla from the back or turned in from the chest thus precluding scar torsion of the axillary contents as well as a degree of contracture interfering with abduction

Derangements of the axilla (segmental or general) are usually made up of scar contractures and webs The latter may be

either congenital or traumatic Either may produce unusual distortion or even displacement of the axillary contents

In the reconstruction of the scarred axillary space, the scar tissue must be completely eradicated, including that involving the deep vessels and the nerves of the axillary space, but care must be exercised in this connection when the arm is being abducted so as not to injure any of its contents This is emphatically true in cases where the contracture has existed for many years and has resulted in a foreshortening of the axillary contents Ultimate functional reconstruction in such cases may necessitate separate operative procedures At first, complete eradication of the scar tissue and the attainment of as much extension as is consistent with the integrity of the axillary contents followed by the inshifting of a massive flap is all that may be possible Following this, graduated exercise and stretching of the axillary contents must be instituted to the extent that the flap permits when further extension may be attainable only by the inshifting of a secondary flap, usually from a region opposite from the first In other words, if the first flap has been brought in from the scapular region the next one should be brought in from the thoracic side

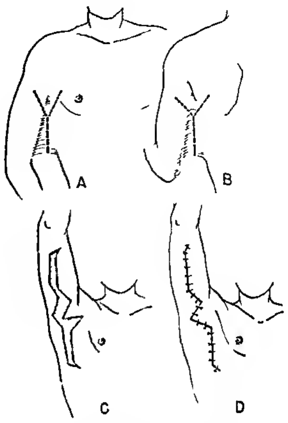


FIG 280 Method of correcting axillary web of medium extent (A) 'Y' incision of web after splitting of latter as in Figure 279 (B) Incision of posterior sheet of web (C) Position of flaps after extension of arm (D) Closure

Webs, whether they be congenital or *traumatic, are best eliminated by splitting* the web into an anterior and a posterior leaf or flap One of the flaps is pedicled on the torso and the other on the extremity The flap which is to cover the axillary region always should be the larger In this way ample tissue is available for doming the axilla and for coverage of the denuded areas, both on the extremity as well as the body (Fig 278) This is not possible in webs which are very short In such cases a multiple flap pattern adequate to the demands of the case must be designed, and the tissues must be undermined well over the dorsal as well as the anterior aspects of the thorax so as to allow for inshifting of the flaps and adequate coverage of the raw *areas (Figs 279 and 280)*

The usual scar contracture of the axilla due to burns is not of the architectural design as illustrated in the foregoing Secondly, it being all scar tissue it does not lend itself to formation and rotation and use of flaps as does the congenital web or the burn web of long standing The webs due to extensive burns almost invariably mean complete excision of the scar tissue and free grafting of the defect (See Chap 20, 'Surgery of Burns)

Excesses A frequent and interesting type of true excess in connection with the axilla is the supernumerary breast These usually contain very little or no breast tissue and

Fig 281 Methods of reconstruction of upper arm (*Top*) Design and placement of thoracic flap pedicled posteriorly for reconstruction of back of arm (*Bottom*) Manner of apposition and pedicling of extensive chest flap to a large defect involving almost the entire posterior surface of the upper arm

rarely a nipple Their extraction means simple but accurate dissection of the mass with isolation and ligation of all principal arteries thereto which occasionally means the complete ablation of the long thoracic Care should be taken in these cases when making or closing the incision so that the closure does not result in a fiddlestring contracture in the anterior axillary fold (See Chap 25 Breast)

The false excesses consist of aneurysms and neoplasms (both primary and secondary) and are primarily a problem for excisional surgery

UPPER ARM

Voids The conditions of concern and interest in connection with the upper arm are scars and soft tissue voids which are the result of extensive burns gunshot wounds bites and avulsions Scars usually can be repaired by excision and rotation of collateral flaps with closure by Z plasty Losses due to bites or gunshot wounds because of extensive loss of soft tissue are usually most expeditiously remedied by the direct transfer of chest flaps to the arm For voids of the posterior surface of the arm the flap is pedicled in the posterior axillary line For tissue losses in the bicipital region the flaps are pedicled in the anterior axillary line (Fig 281)

Derangements unless attended by very extensive scarring are resolved by local tissue rotations If the scarring is deep and extensive the case after scar excision falls into the category of voids (relative) rather than derangements and must be planned and handled accordingly (see Fig 137)

Excesses The main tissue excess involving this region is the adipose arm A fat laden skin apron sometimes of unusual extent hangs from the back of the upper extremity This may be excised in one sitting parallel with Langer s lines of tension A straight line incision and closure will interfere with forward projection and elevation of the arm

ELBOW

Voids Total tissue voids of the elbow region are inconsistent with retention of the forearm and hand due to attendant gross involvement of blood supply and innervation

Partial tissue voids affecting the elbow joint are of two types those involving only the anterior aspect of the elbow or the antecubital fossa and those involving the posterior aspect The former are almost exclusively soft tissue voids involving the lacertus fibrosus whereas the latter almost invariably involve at least the olecranon if not the elbow joint itself With gross injury to the olecranon some degree of involvement of the function of the elbow is practically unavoidable

The most important thing in the soft tissue repair of elbow voids is that they *never should be done with a free skin graft* In the case of antecubital voids this too frequently results in a degree of secondary postoperative contracture whereas in the olecranon area it leads to necrosis and finally chronic ulceration the result of weight bearing The antecubital voids are best reconstructed by a rotation flap taken from the lateral aspect of the forearm and turned up and across the fossa The surgical defect resulting from the rotation of such a flap may then be covered by a free skin graft which does not interfere with the function of the extremity If the free skin graft were placed over the antecubital fossa such a complication is almost unavoidable in due course of time In the case of skin loss over the olecranon the most expeditious and equitable repair lies in the transfer of a flap from the region of the hypochondrium directly to the region of the olecranon Even when such flaps have been successfully transferred one must be careful not to allow the patient to use the elbow joint for weight bearing too early lest the subcutaneous padding fibrose or necrose or liquefy and the flap ultimately sclerose One must wait for complete organization of the transferred tissue to insure free mobility thereof over the olecranon before allowing the patient unrestricted use of the elbow (Fig 282)

Where injury to the elbow joint proper has been sustained coincident with loss of soft tissue (Figs 283 and 284) the problem is more complicated The creation of an adequate joint by bone grafting is as yet not too satisfactory a venture Hence some authors (Mellen Phalen and Burman) have advocated the use of inanimate material such as acrylic or tantalum to produce serviceable joints The employment of such material is too recent to venture any opinion except that as with all reconstructions based upon nonbiologic material the danger

FIG 282 Application of an extensive hypochondrial flap to the region of the elbow and its necrosis over the olecranon due to untimely weight bearing This danger exists for a minimum of 6 weeks following transfer of these flaps Strict discipline must be exercised by patients to avoid such costly complications

always exists that the body tissues will not tolerate such contrivances under duress of function This is particularly true with joints of higher order than mechanical hinges For arthroplasties and reconstruc- sue derangements affecting the elbow are those resulting from the vicious contraction of scar tissue, particularly in the ante cubital fossa The ultimate aim is the com plete extension of the elbow joint This is

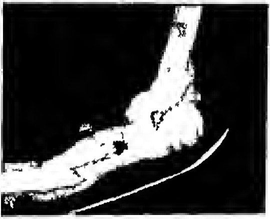


Fig 283 (*Top*) Extensive loss of soft tissue of left elbow joint the result of gunshot wound (*Bottom, left*) X ray photograph of bone involvement (*Bot tom, right*) Soft tissue repair by sub stantial hypochondrial flap (Abdominal tube shown in picture is intended for repair elsewhere Arm rotated forward to show back of elbow)

tions of the elbow joint the student is re ferred to post bellum (World War II) texts on orthopedics or special texts on extrem- ities, viz , Sterling Bunnell's *Surgery of the Hand*, Philadelphia, Lippincott

Derangements The most important tis- attainable only after excision of the scar tis sue Where the contracture has been of long standing, the warning noted under axillary reconstructions in connection with too sudden an extension applies doubly in the case of the elbow joint The need for

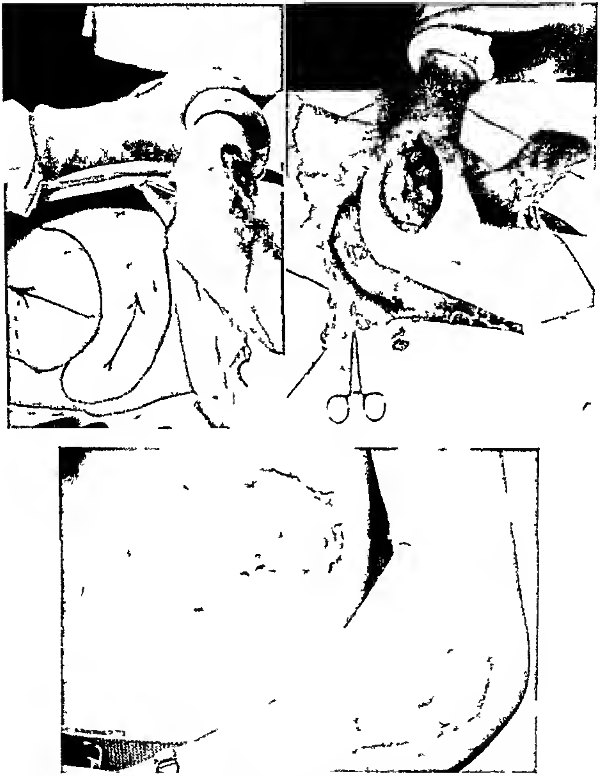


Fig 284 (*Top left*) Design for simultaneous application of two flaps one thoracic and the other abdominal to bilateral elbow defects The elbow defects as illustrated are the result of extensive excision of fibrous tissue involving not only the external arm but the elbow joint (*Right*) Flaps are shown mobilized and ready to be imbedded into the defects The abdominal flap is destined for the medial defect whereas the narrower chest flap is intended for the lateral elbow defect (see Fig 136B) (*Bottom*) Closure of abdominal donor site by rotation of secondary flaps Outer skin covering of lower portion of flap blistered due to hot water bag Immediate free split grafting of that portion of the flap was done to illustrate the possibility of immediate regrafting of flaps when injured (see also Fig 136)

careful gradual and studied extension of the joint cannot be overemphasized lest injury result to either the joint itself or to the foreshortened blood vessels and nerves of the antecubital fossa. Where the scar

Fig 285A Restitution of contracted elbow (*Right*) Extensive scar contracture of elbow region reaching into forearm (*Bottom*) Partial release of contracture after application of free graft Good provisional treatment to avoid sudden release of joint and possible injury to vessels in old cases

contracture is short and not too wide the resultant surgical void after excision of the scar tissue may be repaired by a rotating flap as indicated above. Where as is often the case the defect consequent upon the excision of the scar tissue is a very extensive one the better procedure is to cover the defect by a flap or a tube mobilized in the region of the hypochondrium (Fig 285F)

When dealing with a vicious elbow contracture of long standing a less involved procedure resides in the transection of the

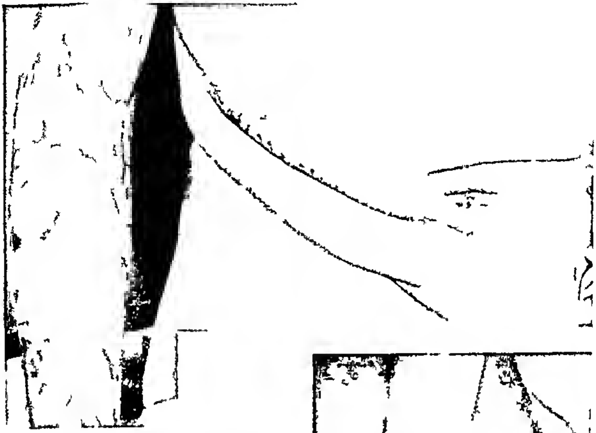


Fig 285B Restitution of contracted elbow (*Continued*) (*Top*) Planning of repair via abdominal tube Note free graft over antecubital fossa and its conditional prevention of complete extension of elbow (*Bottom*) Distal pedicle of abdominal tube jumped to upper extremity Note arrowhead trapping of tube on elbow (see Fig 124)

contracture to a predetermined depth allowing for only partial extension of the elbow joint and covering the raw area thus created by a thin split graft After the maximum extension possible has been thus attained and stretching of nerves and blood vessels secured the split graft is excised and the remainder of the scar is incised down into the antecubital fossa so that its base consists of good viable tissue This creates a larger raw area than the first which can again be interim grafted by a thick split graft usually available from the same donor site where the original thin split graft was taken While now attaining complete extension of the elbow joint a tubed pedicle is prepared in the thoracico abdominal region As final extension of the elbow joint is attained one of the pedicles of the tube is transferred after excision of a por

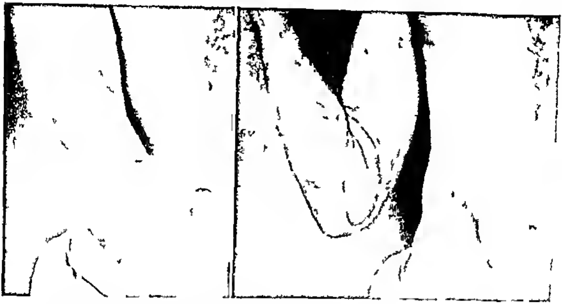


FIG 285C Restitution of contracted elbow (*Continued*) (*Left*) Condition after proper ingrafting of antecubital fossa via abdominal tube (*Right*) Extremity in flexion

tion of the scar tissue into the upper pole of the contracture The persistent extension of the elbow joint is continued in the interim When the circulation through the initially transferred pedicle is adequate the second pedicle is transferred to the region of the inferior pole of the contracture At each step of course the necessary amount of scar tissue is excised One should make certain that the tube is long enough to subserve complete extension of the extremity at the elbow joint Finally the remainder of the scar tissue now lying under the tube and in the antecubital fossa proper is completely excised with its split graft the tube is opened up and so sutured into the fossa The elbow joint is maintained in complete extension until healing and organization take place Passive action of the elbow may be allowed after the twelfth postoperative day Active use of the extremity is permissible after the minimal lapse of 19 days

One of the cardinal derangements of the elbow joint is loss of flexion due to destruction of the biceps muscle This can be satisfactorily corrected in a large number of cases by the flexorplasty of Steindler consisting of transfer of the origins of the wrist and the finger flexor muscles approximately one inch higher on the humerus The flexor muscles are found grouped between the median and the ulnar nerves about the internal condyle The fascia covering this muscle group is incised longitudinally to permit mobilization en masse and suturing to the internal muscular septum higher up This should be done with the elbow flexed The flexion is maintained for a minimum of 19 days then motion may be started

Excesses The tissue excesses occasionally seen by the plastic surgeon involving the elbow joint are superfluous skin hairy nevi bursae of the olecranon lipomas and such conditions as aneurysms which more properly belong in the domain of general surgery From the standpoint of plastic surgery the important problem in the excision of any lesions of the antecubital region is that the closure in its major polarity must run in the crease of the elbow region

FOREARM

Voids The tissue defects in the forearm of most concern to both the plastic and

I LATE II

(*Top*) Consequences of precipitate final transfer of abdominal tube to extensive compound defect of left forearm Note incipient gangrene of edges of the distal two thirds of the graft with vesiculation of the epidermus Nothing is gained by pie crusting such a graft Decortication of the outer layers of skin with immediate free grafting of the original graft may save the repair (*Bottom*) Results of the grafting of a graft (2 weeks postoperative) A thin split graft was applied (0 010 in) over the decorticated area of the original tube graft

FIG 286 (*Top, left*) Extensive soft tissue loss of dorsal aspect of forearm consequent upon open reduction and plating of compound fracture of radius and ulna Note plate showing on medial aspect of ulna Both bones of the forearm at this stage had lost their viability and had to be removed All scar tissue in the depths of the wound was debrided extensively and the defect covered by an abdominal flap (*Top, right*) Forearm imbedded under abdominal flap (*Bottom*) Forearm after complete imbedding of abdominal flap With a minimum lapse of 6 weeks bones of the forearm may be safely grafted by re elevation of the flap

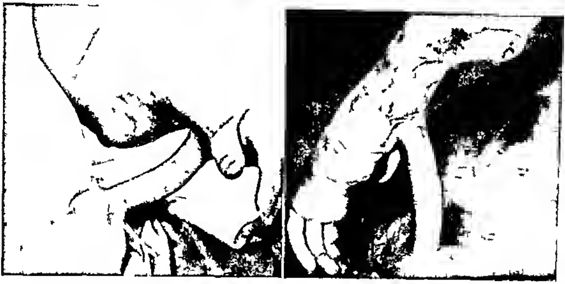


FIG 287 (*Left*) Extensive loss of volar aspect of forearm and method of repair via abdominal tube (*Right*) Attachment of abdominal tube to volar aspect of forearm Note smooth clean condition of defect, the result of use of split skin graft following injury Although tube is shown attached to the distal pole of the defect it is usually better to migrate the tube to the proximal pole of the defect first This guarantees more expeditious circulatory communion between tube and recipient site

the orthopedic surgeons are soft tissue losses with or without bone involvement The former are more common in adults

Extensive soft tissue voids of the forearm may be divided into two classes those affecting the dorsum of the forearm and those affecting the volar aspect of the forearm The former are almost routinely repaired by direct abdominal flaps The volar voids because of the greater need for aseptic transfer of tissue (see Chap 16), are better ablated by the use of large abdominal tubes This additionally provides satisfactory pads of better integrity for the protection of the vital structures in the volar compartment of the forearm (Figs 286 and 287 for gross avulsions see Chap 38)

Derangements affecting the forearm are for the most part the consequence of scarring which unless too extensive in depth, can almost invariably be repaired by the use of free skin grafts

True excesses of forearm tissues are exceedingly rare and consist of duplication of the ulna or radius supernumerary muscles or duplication of the entire forearm False excesses are more common and comprise almost the entire general array of neoplasms including extensive hemangiomas and the hairy nevi Treatment consists of total excision and full thickness grafting (For Nevi see Chap 38)

HAND (MANUPLASTY)

Next to the brain and the genital organs *the hand is undoubtedly the most personal and complicated property of man* The complexities the potentialities and the individuality of the hand are among the things which place man *in such a superior position* over the animals Therefore a more detailed differentiation and approach to the types of injuries of the hand are pertinent to the student of plastic surgery (*Fig 288*)

Voids

TOTAL VOIDS of the hand are comparatively common in war surgery They are not uncommon in industry Obviously there is little that the plastic surgeon can do except

to prepare the forearm for a cineplastic prosthesis (see Cineplasty at the beginning of this chapter)

Partial Voids Tissue voids of the hand for practical reasons may be divided into soft tissue voids and compound voids

More and more interest is shown every day particularly on the part of the industrial surgeon as to how much hand tissue may be immediately replaced following its accidental amputation Such injuries are very common in industry Though the adequate physiologic reconstruction of any total part of a finger is still an unsolved problem in plastic surgery it should not be surprising that those who are faced with such injuries and stimulated by the advances being made in reconstructive surgery should be tempted by the idea of immediate replacement of severed portions of the fingers

It is important in this connection to note what is meant by the amputation of a finger or part thereof Caution is stipulated for the benefit of the student since it is not uncommon to hear patients and occasionally surgeons remark that two or three fingers were completely amputated located eight hours or more after the injury sutured back into position and satisfactory results obtained It never has been the author s good fortune to be able to witness such a result Upon closer questioning it is not unusual to find the eventual admission that the supposedly amputated finger or part thereof actually hung by only a bit of skin a tendon and one blood vessel Obviously this is not an amputation Such lacerations or avulsions plus knowing and meticulous apposition of the various other severed parts of the finger plus intelligent splinting may and often do result in the saving of the injured part But complete amputation with the unquestionable microscopic and pathologic changes which take place in severed tissue within two or three hours after amputation makes such assertions of results doubtful to say the least

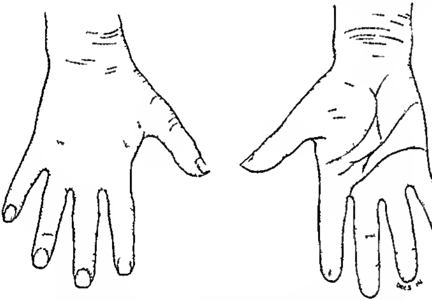


Fig 288 Langer s lines of skin tension in the hand They are more consistent here than elsewhere on the body

Minimal partial losses of a finger are subject to adequate reclamation following meticulous surgery provided that infection does not intervene Where these losses involve a portion of the finger beyond the terminal phalanx the good results and the

FIG 289 Method of reapproximation of completely severed distal third of finger and its imbedding into thenar region of hand after complete avulsion of the skin except for a single lateral attachment Adequate postoperative splinting is imperative

reports thereof are questionable This statement is based upon the assumption that the lost portion of a finger is sutured back in a gross anatomic position

Where a portion of the finger not involving or exceeding the distal joint is amputated accidentally it is possible if one can retrieve it immediately to restore it with a fair degree of success by meticulous apposition of all its parts Even so the splinting and the re establishment of circulation is a difficult problem Since one encounters the greatest difficulty in establishing circulatory communion between the volar aspect of the skin and its source of supply it is best to excise the skin in the form of a full thickness graft implant the denuded tip of the finger in a good source of blood supply and then appose the injured finger to it (Fig 289) The skin in the form of a free graft which has been excised from the pad of the finger should be saved by implanting it in the vicinity of the tip When healing between the amputated tip and the finger proper has taken place (a minimum of four weeks) the finger is then excised with a small flap of skin which serves to cover the finger pad for the time being After the lapse of another three or four weeks or until one is quite certain that the attached finger tip will not undergo gradual mummification the skin of the flap on the pad of the finger may be carefully excised and replaced by the original skin which has been conserved by implanting it in the vicinity of the implanted finger tip Several such operations with gratifying results have been performed by the author

Gillies in 1940 described an operation for the replacement of a center digit which was employed in 1944 by Stewart Gordon of Toronto Gordon s case involved a soldier who suffered a traumatic amputation through the middle of the proximal phalanx of the left thumb The patient arrived at the hospital two hours after the injury Gordon states One digital nerve was the only communication between the stump and the distal portion of the thumb The patient was operated on three and one half hours after injury The skin subcutaneous tissue nail and nail bed were removed from the amputated portion and it was found that the capsule of the interphalangeal joint had been torn open on its dorsal aspect The fracture of the bone was a T shaped one with the vertical line running distally into the joint * Gordon approximated the fractured bone by stainless steel wire which he did not feel gave adequate fixation and so the surgeon refrained from suturing the tendons The denuded portion of the thumb was then inserted into a tubed flap which

* Gordon S Autograft of amputated thumb Lancet 2 823 1944

was approximated to the skin edge of the stump After three weeks the tube was opened on the palmar surface and the flexor longus pollicis tendon was sutured Two weeks later the tube was narrowed and in another three weeks it was divided and the end was trimmed and closed

Gordon states that after four months the thumb could be approximated to the tip of each finger and could grip From this Gordon concludes that Gillies prediction was justified

Basically this has been the author s experience and is entirely consistent with our present knowledge of the physiology of tissue transplantation

In connection with this type of injury it may be found that all of the soft tissues of the severed portion of a digit may have been so macerated as to make the aforementioned procedure out of question In such cases particularly where the bone content of the amputated portion of the digit does not reach beyond the distal joint it may be filleted or in other words completely freed of all its soft tissue investments except the periosteum The bone is then buried in an appropriate place usually on the medial side of the tibia or the dorsal aspect of the middle third of the ulna over an incision of the periosteum The injured digit is then sutured into a tubed abdominal flap as suggested by Gillies and reported by Gordon When the injured finger is amputated with its abdominal pedicle the filleted distal phalanx may then be retrieved and inserted into the tube It must come in contact with the distal end of the middle phalanx of the injured finger The newly created terminal portion of the digit is then flexed in a more or less functional position and the entire ensemble is splinted This is not intended to give a truly functional terminal phalanx of a finger but simply a secure elongation similar to the post type of thumb but with architecturally ideal bone

Where only the soft tissues of the tip of the finger are lost specifically the pad of the digit the simplest procedure is to suture the digit into a prepared abdominal flap after proper preoperative preparation of the injury including necessary debridement After from two to three weeks the injured digit may be amputated with its flap and the latter trimmed down and sutured carefully into position on the ball of the finger (Fig 290)

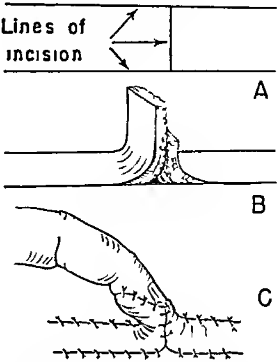
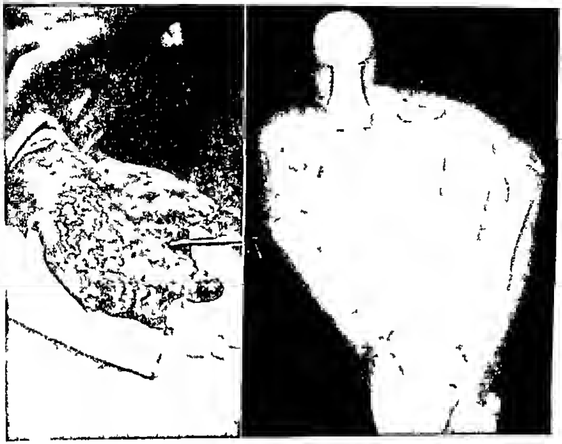
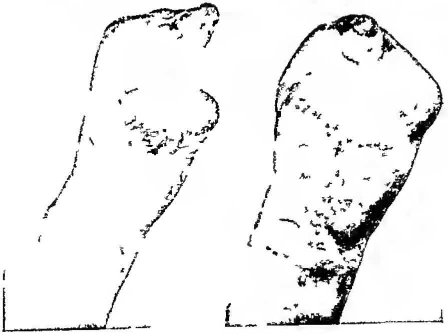


Fig 290 Bunnell s procedure for reconstruction finger pad (A) Linear approach to abdominal donor site (B) The two flaps undermined and brought into apposition by two fine catgut sutures (C) Injured digit approximated to abdominal flaps

The next most common type of acute tissue loss of the hand is the so called avulsion This more frequently involves the dorsal aspect of the hand than its volar but may involve both and result in the loss of skin alone or all of the soft tissues covering the bones of the appendage Where the deeper tissues are involved usually some degree of actual loss of the digits is sustained

Where the loss does not involve the





tendons themselves and the hand is received in an obviously uncontaminated condition immediate free skin grafting after proper preoperative preparation is permissible This type of coverage is the only guarantee of early ambulation and healing Equally important in this connection is the prevention of the eventual loss of the intrinsic musculature of the hand This is a serious consideration in the treatment of acute soft tissue losses of the hand in connection with future reconstruction As long as the intrinsic musculature of the hand is intact there is always hope of coming through with a useful appendage (Fig 291)

Where more than skin and subcutaneous tissue is involved and particularly where there is obvious injury to the tendons such a hand should be covered with an adequate abdominal flap Such management will not only result in the saving of all that is left of the hand but also acts as a good basis for subsequent reconstruction of the appendage (Figs 292 and 293) Thus it is imperative for the general surgeon to be conversant with the preparation and the immediate transfer of flaps for the ablation of acute tissue losses This is a more important phase of original repair than is generally realized or advocated It can be the foundation of subsequent more specialized repair and often is its only hope Such ultimate specialized procedures are many and complicated and not necessarily of practical concern to the general surgeon or student

Specific partial voids of the hand are illustrated by the absent thumb It is well known that the thumb is such an important part of the hand that every effort should be made for its replacement Mechanical thumb prostheses are available and although esthetically satisfactory, are functionally inadequate and are seldom worn very long by the patient

There are six methods of reconstructing the thumb phalangization (Fig 294), pollicization rotary angulatory osteotomy, the post in tube graft digital transplantation and Bunnell s physiologic thumb Phalangization consists of the deepening of the web between what is left of the thumb and the hand In this procedure the adductors of the thumb and the first dorsal interosseus muscle must not be severed but their insertions must be mobilized and attached proximally on the thumb to retain action Rotary angulatory osteotomy through the metacarpal or proximal phalanx is done on remaining digits which may thus be made to face each other and so give prehensile action Pollicization means the transplantation of a digit with a part or the whole of the metacarpal to the stump of the metacarpal of the thumb or to the trapezium The tubular bone post type of thumb is one constructed from an abdominal tube which is first approximated to the position originally occupied by the thumb and then made rigid by the insertion of a bone graft which is wedged into the trapezium or what has remained of the original thumb Digital transplantation may involve the transfer of a toe to the hand or one of the fingers from an uninjured hand to the affected one

In a true sense none of the foregoing is an adequate physiologic thumb wherefore Bunnell has devised a procedure approximating a physiologic thumb The procedure is only possible where specialized conservation of the metacarpal and at least a portion of the proximal phalanx of the index finger are available with the muscles the

Fig 291 (*Top left*) Complete avulsion of hand and distal fourth of forearm with extensive amputation of digits Injury the result of getting hand into boxcar joint (*Top right*) X ray of injured hand (*Bottom left*) Appearance of appendage 3 months after free grafting Patient by this time was able to pick up and hold pencil cork or 50-cent piece with remains of index finger and stump of thumb This was made possible by conservation of intrinsic musculature through adequate grafting (*Bottom, right*) Palmar aspect of hand 3 months postoperatively

tendons and the nerves normally present This entire ensemble is then mobilized from the hand proper and transposed and rotated into the position of a thumb by means of disarticulation from the carpus so it can be transposed to the trapezium With this must go the volar digital nerve to the second interdigital cleft and the volar artery Finally all the thenar muscles must be attached to the metacarpal of the transposed

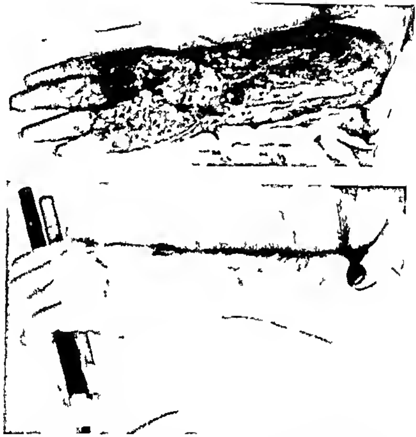


FIG 292 (*Top*) Extensive wringer injury and burn combined of the upper extremity of a 3 year old boy Note extrusion of the ulna Distal extremity of radius was fractured and dislocated All but one carpal bone was completely burned so that the hand was attached to the forearm by the volar tissues only Wound when received was infected Distal two thirds of ulna were sacrificed and poultices of phosphoric acid were applied to hand Patient was given systemic penicillin Treatment continued for 10 days when avulsion was clinically clean Upper forearm was then free grafted and wrist and hand imbedded under large abdominal flap (see Plate 12) (*Bottom*) Appearance of upper extremity 6 months postoperative at which time child was able to close hand and pick up small objects as well as large ones Note closure of raw surface on upper forearm by split graft By projecting a flap of subcutaneous fatty tissue from abdominal flap into remains of wrist joint and approximating muscles of forearm to periosteum of proximal ends of metacarpals child was able to extend at the wrist joint He is not able to extend fingers except by intrinsic muscles Ulna regenerated

PLATE 12

Extensive compound avulsion of tissues of forearm elbow and hand in a 3 year old boy the result of a wringer injury Note presentation of dead ulna muscle injuries complete necrosis of the wrist including joint and edema of hand The case was seen 16 days aftery injury with *B pyocyaneus* and *Streptococcus* infection Cleaned up with 1 per cent phosphoric acid and penicillin chlorophyll was used locally and imbedded in extensive abdominal flap (For postoperative results see Figure 292)

index finger so as to be capable of thumb action

Any or all of the methods cited can be performed only under specified conditions on particular cases and all have their technical or physiologic drawbacks The total construction of a thumb remains one of the outstanding problems in plastic surgery and is discussed here only insofar as its existence is pertinent to the knowledge of the student rather than the advantage of the general surgeon

There are three donor sites for the bone necessary in the total reconstruction of a thumb namely the floating rib the tibia or the crest of the ilium The crest of the ilium though easily available consists for the most part of cancellous bone and therefore lacks the strength of the other two The tibial source though easily accessible in contrast with the ilium is largely composed of cortical bone and therefore increases the problem of circulatory communion within the tube There is another technical objection to the use of iliac or tibial bone which is based upon the established principle that a bone graft survives best when both the ends are in contact with bone This of course is impossible in the construction of a thumb That is not to say that bone will not survive where it is adequately attached to one source of blood supply because experience has shown in the use of bone grafts in other locations such as the reconstruction of the dorsum of the nose that a bone graft will survive and even grow when attached at only one end

There is a source of bone for purposes of reconstruction of the thumb which avoids this difficulty to some extent and that is the floating rib Inasmuch as this rib terminates in cartilage and cartilage survives more easily even when lying free in a tissue the floating rib makes a better material for the reconstruction of the thumb Its length shape and lability is of such nature that it is easily carved for this purpose Its unattached bony end survives with greater

Fig 293 Amputation avulsion of digital part of hand and results of immediate imbedding under abdominal flap

ease because its terminus is in the form of cartilage

Derangements Segmental Derangements The most perplexing tissue derangement to the industrial or general surgeon is the acute avulsion Nowhere is intimate knowledge of the principles of plastic surgery and of original repair so pertinent and profitable as in the management of these cases (See Chap 38)

Parallel with the closure of the raw area consequent upon acute avulsion there is almost invariably need for extensive repair of tendons Where parts of tendons are lost the gap may occasionally be bridged in a clean wound by one or another method of lengthening Where bone tissue is lost or must be removed for purposes of immediate closure and original repair an occasional tendon may have to be shortened Therefore the surgeon must be conversant with some reliable method of approach in the management of tendon injuries Only the recognized standardized approaches are illustrated (Fig 295)

Avulsions occur most frequently on the extremities yet because they usually involve only skin and subcutaneous fat they

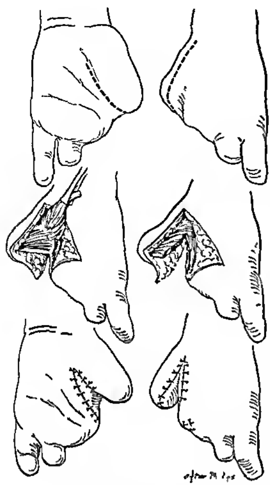


FIG 294 Phalangization of thumb (Kessler)

will be discussed in Chapter 38, "Surgery of the Skin"

The outstanding traumatic derangements (distortions) encountered in the management of hand injuries are those resulting in scar formation These hand defects for practical purposes may be divided into three types the scars involving the dorsum of the hand (extensor contracture), those involving the fingers and/or the palm of the hand (flexor contracture) The management of the first, from the standpoint of functional results is undoubtedly the easiest in that, following scar excision, all that is necessary is to cover the surgical defect with a thick-split skin graft This is a practical and expeditious solution to the problem, although not entirely satisfactory from an esthetic standpoint The free skin graft is notorious for its lack of dependability as to pigmentation and the resultant color match with the surrounding uninjured skin When the free skin graft fails to attain an acceptable degree of pigmentation, remaining either too pale or too bronzed, the hand looks like a patched glove The total removal of the scar tissue from the dorsum of the hand and its substitution by a free split skin graft fairly well resolves the immediate problem, that is, the restoration of flexion The ultimate failure to attain normal color may overshadow the functional results obtained by the free graft

Since the split free skin graft is essentially the product of human ingenuity rather than an adequate anatomic replacement, one must replace the loss by its equivalent in order to attain normalcy The nearest approach to the ideal normal in these cases is the dorsal skin of the forearm The surgical problem is to transport this under as nearly ideal conditions as possible to the dorsum of the hand Whatever the reason for the loss of the skin of the dorsum, whether due to a burn, avulsion or neoplasm, restitution is more fully attained by the following method in selected cases

After excision of the affected dorsal surface of the hand, two roughly parallel incisions are made, extending onto the dorsum of the forearm as far as necessary and consistent with the principles covering a pedicle graft This outlined flap is then carefully undermined, and its scant subcutaneous tissue is taken with it If the incisions have been made to the proper depth, the skin being normally loose over the forearm, the flap can be elevated by undermining with the gloved finger The loosening of the flap from the forearm permits one to advance it from 1½ to 2 inches (3 8 to 5 cm) distalward (Figs 296 and 297)

If the hand is then dorsiflexed at the wrist, another 1 to 1½ inches (2 5 to 3 8

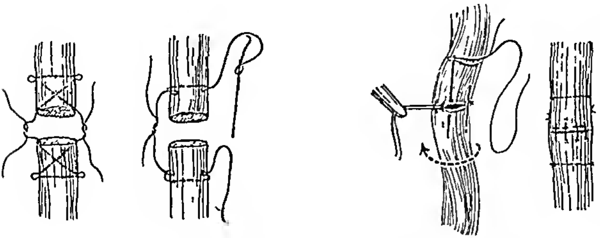
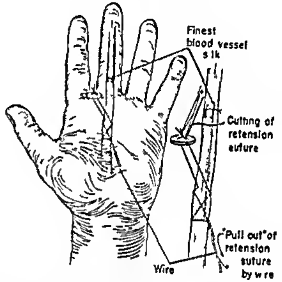


FIG 295 Management of tendons and tendon injuries (*Top*) Mason-Koch method of tendon suture (*Bottom*) Bunnell's method of primary tendon repair by use of pull-out wire suture



cm) may be gained in the advancement Hence, an excision up to 3½ inches (9 cm) from the dorsum of the hand can be made and covered with the nearest possible anatomic equivalent The dorsum of the hand of an average male adult is seldom over 3½ inches Even so, when complete excision has to be done and when the quality of the circulation in the forearm skin may not be equal to the task, it is advisable to practice 'delay" of the flap Such a decision is a matter of surgical judgment and experience In any such procedure, it is better first to mobilize the forearm flap and investigate its integrity before excising the affected dorsum of the hand

The affected dorsum having once been excised and the hand placed in dorsiflexion, the distal part of the flap is temporarily attached to each dorsal fold of the interdigital webs Or, if the skin over the metacarpophalangeal joints was not excised, the flap is attached to the skin just proximal to the joints At this point it must be emphasized that when one is excising the affected skin of the dorsum of the hand, the excision must be so planned that the resulting suture line is either somewhat proximal or somewhat distal to the metacarpophalangeal joints This obviates the nuisance of a scar over a joint

After the forearm flap has been temporarily attached to its predetermined distal position, with the hand in dorsiflexion, a temporary anchor suture is placed through the flap on each side of the wrist, approximating it to the concavity of the dorsum of the wrist The entire flap is then permanently and completely sutured to the two sides of the extremity by either interrupted or continuous but 'advancing" sutures This opposes the tissues in proper tone and, of course, in the direction of greatest benefit, which is distalward

Fig 296A Dermoplasty of dorsum of hand (Pick's method) (*Top*) Case suitable for dermoplasty of healed third degree burn of dorsum of hand *without implication of extensor tendons Complete closure of this type of* hand is limited by scar tissue on dorsum (*Center*) Dotted line over dorsum of hand indicates extent of excision of scar tissue at first sitting Dash lines

After the entire area of the dorsum of the hand has been covered three or four mattress sutures are placed through the skin now overlying the wrist and anchored to the underlying bed These mattress sutures are then tied over a large soft rubber catheter rolled in petrolatum gauze The ends of the catheter may be loosely tied under the wrist if desired The object to be realized is the obliteration of the dead space which unavoidably exists between the flap and the concave dorsum of the wrist once the distal end of the graft is anchored to the fingers Should this detail be omitted the flap would form the hypotenuse of a triangle whose other two sides would be the distal portion of the forearm and the dorsum of the hand respectively This would result in a dead space

The remainder of the operation consists of applying dressings appropriate for a pedicle flap and a cock up splint which will maintain the hand in dorsiflexion for from 16 to 21 days With the expiration of two weeks the cock up splint should be removed every day the hand and the forearm properly cleansed and light passive flexion instituted to prevent stiffness and to inaugurate stretching of the skin over the wrist Within a week it will be found that the patient is able to project the hand on the forearm Complete flexion at the wrist is still difficult and undesirable It over stretches the dorsal suture line At this point active moderate use of the hand can be permitted Within a week to ten days the patient is able to flex the extremity at the wrist without effort

Scarring of the fingers is best remedied wherever possible by thick split or full thickness grafts in combination with multiple Z plasties This is particularly true of the volar aspects of the fingers This in

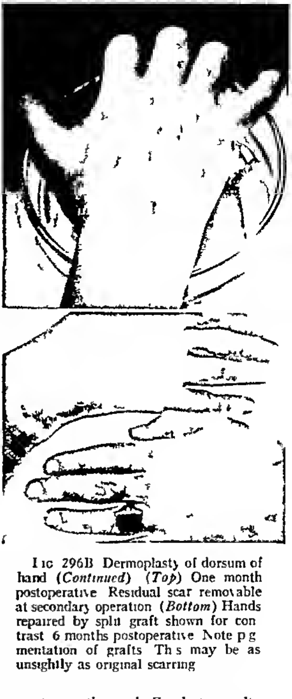


Fig 296B Dermoplasty of dorsum of hand (*Continued*) (*Top*) One month postoperative Residual scar removable at secondary operation (*Bottom*) Hands repaired by split graft shown for contrast 6 months postoperative Note pigmentation of grafts This may be as unsightly as original scarring

connection with serial Z plasty results in the best functional restoration The exclusive application of free split skin grafts to the volar surface of the fingers is never a

Fig 296A (*Continued*)
over forearm indicate outline of flap to be advanced over dorsum of hand with latter splinted in complete dorsal extension postoperatively (*Bottom*) Dissection and elevation of scarred dorsum of hand as well as flap of dorsum of forearm which is to replace scar tissue by advancement

satisfactory procedure This, as a matter of fact applies to the entire volar aspect of the hand (see Fig 52)

When the palm of the hand is affected by scar tissue, its complete eradication usually exposes many of the tendons of the palm, in such instances the best functional reconstruction is attained by the use of pedicle flaps These should be transferred with their entire subcutaneous fatty content Even though the latter, for the time being results in a bulky repair of the palm the fat always can be partially excised at such a time as a tendon reconstruction is done Without the presence of some fatty tissue under the graft the results of tendon reconstruction are functionally problematic because of their tendency to adhere to the overlying graft Whatever method of repair is used in the reconstruction of the volar surface of the palm of the hand or the fingers the patient should be instructed not to abuse the repair too early after surgery, that is not *until complete organization of the graft* has taken place Considering the nature of the work which the hand performs daily, particularly in those who earn their living by manual labor, such a hand should be protected for three or four months

General Derangements

Dupuytren's contracture is another condition *frequently seen affecting the hand* This is a fibrotic condition of the volar aspect of the hand with essentially objective findings, resulting in flexion contracture of one or all of the fingers of the hand It is found in approximately 0 1 0 2 per cent of the population As a rule, it is a condition which affects those who do not use their hands for manual work Its etiology is unknown

Fig 297A Dermoplasty of dorsum of hand as applied in case of biopsy excision of epithelioma

The condition has an unpredictable rate of development and usually begins by a feeling of stiffness in the hand which is sooner or later followed by a nodular feel or appearance of the skin of the palm distal to the flexion creases Subcutaneous bands of thickened palmar fascia develop which most frequently affect the ring finger and subsequently the adjoining fingers Following the thickening of the palmar fascia,

induration develops in the hand with adhesion of the overlying skin to the underlying fascia When the condition attains maturity the hand may become almost useless except as a hook Although usually unilateral the condition may be bilateral

The accepted procedure for remedying the condition consists in complete excision of all of the fibrous tissue and thickened fascia through an incision parallel to the distal crease of the palm pointed toward the ulnar border where it turns proximally

Fig 297B Dermoplasty of dorsum of hand (*Continued*) (*Top*) Lesion excised and forearm flap mobilized in preparation for shifting and coverage (*Bottom*) Flap shown advanced over dorsum of hand Hook is inserted into small triangular fibrosed area the result of former x ray therapy This triangular area is staged for additional excision

Fig 297C Dermoplasty of dorsum of hand (*Continued*) Coverage and approximation of forearm flap to bases of digits For purposes of illustration bilateral nippling of skin at base of flap allowed to remain pro tem otherwise excised routinely From that point on incisions are carried just below the radius and ulna respectively to the elbow if necessary

along the course of the flexor tendon of the little finger to the base of the palm This may be done under block anesthesia and always should be performed with a tourniquet The dissection of the fibrosed palmar fascia is best done with a sharp scalpel Care should be taken in the dissection not to open any tendon sheaths or to sever any nerves or the lumbricale muscles

Where the hand has been contracted for a matter of years the same principle applies here as in the extension of any other joints following scar tissue excision it must be done with care and only in accordance with the elastic timber of the blood vessels and extensibility of the nerves Where the contraction of the latter tissues is so great as not to permit adequate extension and particularly if this is associated with joint involvement it may be necessary to amputate a finger so affected rather than to compromise the over all result

In almost all cases following the elimination of the scarred fascia it will be found that the remaining skin is inadequate to cover the defect If this is not too large or too deep it may be ablated by a thick split free skin graft or, if the bed has ample circulation a full thickness free skin graft may be used Where prior to the operation it is obvious that most of the skin of the palm may have to be sacrificed because of its sclerosed and adherent condition to the underlying tissues an abdominal pedicle should be prepared tubed and at the proper time attached to the forearm just proximal to the wrist where it will be ready for implantation into the palm of the hand after excision is completed Following complete ablation of the surgical wound a pressure dressing must be applied which fits accurately into all the crevices of the hand and little effort should be made to extend the fingers completely at once This is attained *gradually* by passive exercise *after the first* eight to ten days Not too much time must be allowed to elapse before some type of motion is instituted in the fingers because patients suffering from Dupuytren s contracture are notoriously inclined to develop stiff joints and contraction of ligaments (Fig 298)

Volkmann s Contracture Another condition not infrequently seen by the plastic surgeon is the so called Volkmann s ischemic contracture This is a posttraumatic condition resulting from ischemia of the contents of the fascial spaces on the volar aspect of the forearm and involving all of the tissues contained therein The muscles are most formidably affected These undergo fibrosis resulting in the partial or total occlusion of vessels strangling of the nerves with paralysis of the intrinsic musculature of the hand and all of the objective signs of impaired nutrition of both the hand and the forearm It is a rapidly developing condi

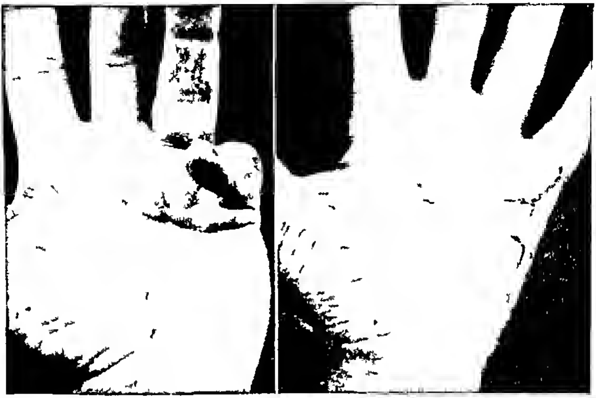


FIG 298 Bilateral Dupuytren s contracture (*Left*) Left hand showing extreme contracture of little finger and beginning contracture of ring finger (*Right*) Left hand 3 weeks postoperatively Dark lines indicate original incision approach (no recurrence 6 years postoperative)

tion usually in association with constricting dressings or plaster of paris casts

The mechanism of the development of this condition is not too far removed from the phenomena attending a strangulated tubed pedicle The ultimate pathologic results are those primarily consequent upon venous obstruction or strangulation

The treatment of Volkmann s ischemic contractures is at first entirely dependent upon patience tenderness considered splinting calculated passive motion guarded active motion of such parts as are movable intelligent physiotherapy for the purpose of increasing arterial blood supply and eventually open operation This consists of excision of all scar tissue mainly that involving the muscle freeing the latter of all adhesions so as to allow for expansion increased circulation and metabolism and freeing of blood vessels nerves and tendons Usually the tendons must be lengthened by slitting sliding the segments one upon the other and then resuturing them either with fine silk or by means of Bunnell s pull out wire suture technic Where there is considerable joint involvement as is usually the case with the wrist arthrodesis must be performed Later on muscle transplantations or substitutions can be performed For the latter two the student is referred to more extensive books on hand surgery

THE FROZEN HAND Occasionally following more or less severe injury a class of hands is encountered which are sometimes referred to as frozen hands and congealed hands The two reduced to a common denominator have certain basic

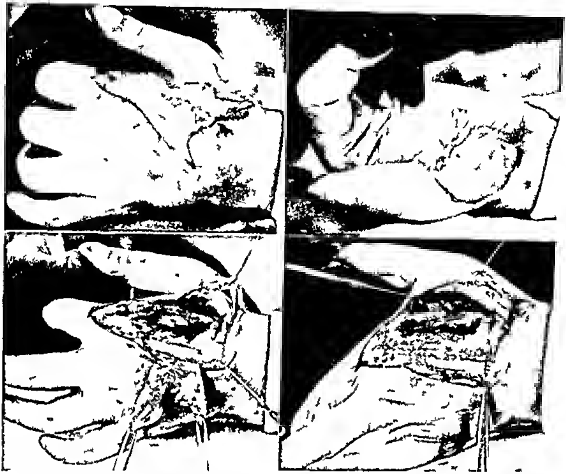


FIG 299A The "freezing" hand (*Top left*) Methylene blue outlines extent of healed wound of exit of bullet injury to dorsum and first web of left hand Note thumb of patient being forcibly abducted by gloved hand of surgeon to illustrate degree of "freezing" (*Top right*) Methylene blue outline delineates extent of fibrosis of healed wound of entry of bullet injury to palm and thenar eminence of hand Note forcible extension of thumb and flexion of index finger by surgeon to illustrate degree of excursion possible Also observe retraction of palmar flexor mechanism into depths of first web (*Bottom left*) Exposure of fibrosed and deranged dorsal interior of injured hand Note thickness of reflected fibrous tissue and displaced tenomuscular mechanism with tendons completely imbedded in fibrous tissue Also observe neurocirculatory involvement of fingers (*Bottom right*) Wound has been completely cleaned of fibrous tissue Note replacement and freedom of muscle elements as well as clean volar muscle bundles showing in depths of wounds area subjacent to thumb

physiologic things in common Although from the standpoint of treatment they differ in that the mechanism of their development and the sequence of pathologic events seems to be reversed in the production of the ultimate clinical picture

The first basic thing which they have in common is the fact that they usually occur in individuals labeled as suffering with constitutional inferiority The second thing is that they are constantly painful hands and the pain is aggravated by the slightest change of temperature use position and even individual disposition The pathologic physiology is a vicious circle of pain extremes of vasospasm or vasodilation swell

FIG 299B The freezing hand (*Continued*) (*Left*) Abdominal flap with tubed peduncle sutured into dorsal defect immediately after scar excision and freezing of thumb (Black area on thumb is a dry vesicle) (*Right*) Showing under side of hand with direct abdominal flap to palm Note tubing of peduncle of dorsal flap Simultaneous transfer of two separate abdominal flaps to a hand is a time saving procedure It must be well planned geometrically and anatomically to permit ease of dressing splinting and successful results

ing sweating blistering discolorations and ultimately gangrene or mummification

The clinical picture differs somewhat in the frozen and congealed hand in that the former usually follows an injury whose consequences are mostly apparent at first in the bony and supporting structures of the hand This may be associated with a certain amount of coincidental nerve involvement This is followed by early fibrosis and deformity leads to swelling and interference with circulation thus ultimately affecting the soft tissues of the hand The fibrosed and deforming hand eventuates in an appendage which becomes swollen discolored painful and useless The final clinical manifestations are considerably out of proportion to the original injury The congealed hand is usually one in which the consequences of original trauma appear only in the soft tissues with a rapid development of swelling discoloration pain and sweating This ultimately eventuates in a pitless hard and contracting appendage The appearance of ankylosing joints shortening tendons dislocations and gross decalcification of the bones comes on only later

In other words whereas the *frozen hand* begins with joint fibrosis and bony involvement leading to interference with the circulation and functional integrity of the soft tissues the *congealed hand* begins with

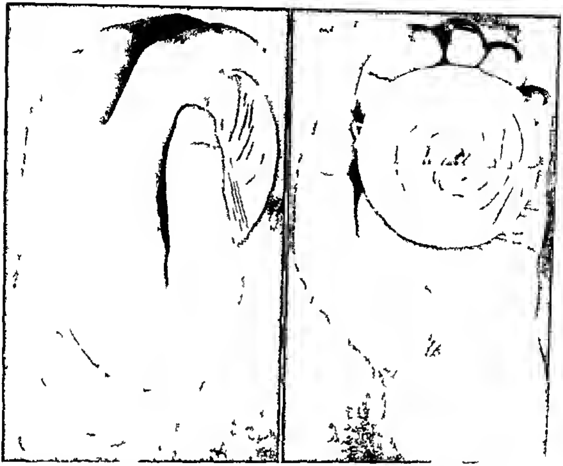


FIG 299C The freezing hand (*Cont m cd*) (*Left*) Showing return of funct on of thumb and index finger as well as improvement in neuroc rculatory integrity of hand The skin of thumb is still thin and shiny but the hand in general is unfreezing Note good formative results from use of adequate flap around first web (Two months post operative) (*Right*) Showing reconstruct on of palmar aspect of same hand Note good formative appearance of thenar em nence and general neurocirculatory improvement of hand Suture line of distal extremity of graft running into first web to jo n posterior flap graft is almost impercept ble (Two months postoperative)

circulatory trouble swelling lymphostasis and early loss of functional integrity of soft tissues eventually implicating the joints and the bones of the appendage (Fig 300) The frozen hand is based initially on the essentially physical factor of extensive fibrosis and its neurocirculatory conse quences whereas the congealed hand de velops on the basis of a pathologic physi ology of the neurocirculatory component of the appendage leading to extensive fibrous involvement of the hand

In any case the ultimate pathologic resi due is an appendage which is cold painful numb useless dystrophic to deformed whose functional reclamation is problematic and often impractical

The management of such hands is ex tremely difficult A vicious circle exists be tween the tenderness and the pain present and the vascular phenomena evident This vicious circle must first be broken some where in order to approach the problem of functional reconstitution If the recurrent

pain can be traced to a 'trigger point,' as Bunnell calls it, this must be removed before the patient allows any manipulation of the extremity whatsoever This may be accomplished by local injection of procaine periarterial sympathectomy, paravertebral injection of the ganglia, or sympathectomy Once this has been accomplished and the pain relieved for variable lengths of time, some semblance of motion can be instituted in the extremity with improvement of circulation and metabolism If this is accomplished early enough in the development of the syndrome such an extremity may be saved from the contracture fate and with eventual prolonged physiotherapeutic treatment rehabilitated to a point of fair usefulness Where secondary pathologic changes have occurred mainly of the fibrotic type reconstructive surgery may be necessary (Fig 299)

Since the fibrosis present in the frozen hand comes on relatively early and is more or less the direct result of the physical trauma, such an appendage is more easily reconstructed because the fibrosed tissue can be eradicated before the soft tissue or congealing phase begins The removal of the fibrosed tissue disposes of its influence upon the neurocirculatory integrity of the appendage and thus limits the syndrome at that point In the congealed hand, how

FIG 300 (*Top*) The 'frozen' hand Contrast with 'congealed' hand below (*Bottom*) The 'congealed' hand This patient sustained a comparatively small third degree burn involving outer and dorsal aspect of thumb with a partial bracelet burn to the wrist The hand is shown after free grafting of thumb Within 2 months following injury, the hand became tightly swollen red, stiff, painful and useless Prolonged manipulation and physiotherapy with sympathetic block were necessary to restore the hand to usefulness

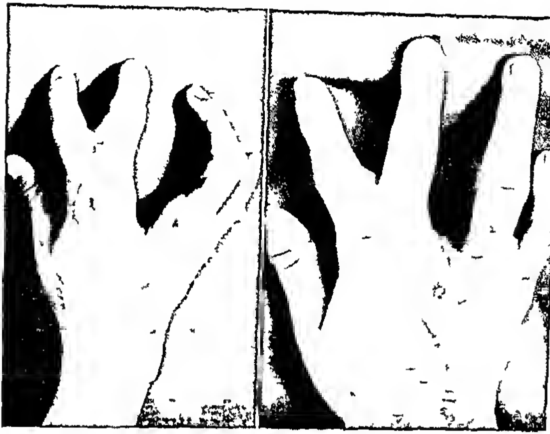


FIG 301 The cleft hand (*Left*) Dorsal view of cleft hand (*Right*) Dorsal view after closure of cleft with correction of rotation deformity of ring finger Only partial correction of second web could be risked at the same time due to circulatory implications Note extent of dorsal incision to allow for rotation of ring finger metacarpal

ever the fibrosis is delayed and essentially due to the interstitial edema with precipitation of the protein fraction from the lymph leading to fibroblastic proliferation throughout the soft tissues of the hand and ultimately a complete coagulation of the tissues There is of course coincident involvement of the joints with stiffening and deformity resulting in complete crippling The early treatment of this type of hand is much more difficult because of the extensiveness of the primary involvement of the soft tissues This is not amenable to direct surgical attack until the appendage has cooled off by which time the pathologic damage is so extensive and the remaining anatomic integrity so minimal that amputation may be necessary The avoidance of amputation as mentioned heretofore is entirely dependent upon control of the neurovascular aspect of the condition in the initial stage of the development of this syndrome

CLEFTS The most common congenital derangements are the clefts and webs In the strictest sense of surgical evaluation they cannot be classified categorically for many are associated with supernumerary digits and would thus fall under the Tissue Excesses whereas a large percentage do not have adequate tissue present for reconstruction and because of the parallel deformities they must be placed under Derangements Where the webs are attended by fusion of

digits and some of the latter are functionally as well as anatomically useless they may conceivably fall into the class of Voids (potential) because of the need of tissue for adequate repair Nevertheless every case is subject to classification only after adequate inventory as discussed in Chapter 9 Diagnosis (cf Principles under Surgical Differentials)

The cleft hand is included under derangements of the appendage because as a rule there is no actual lack or superfluity of tissue but rather a derangement of it consequent upon congenital maldevelopment These appendages sometimes referred to as split hands although usually unilateral are often bilateral The essential functional implications of this type of hand are a weakness of grasp with the tendency toward centripetal gathering of the digits into the palm Through ablation of the clefts not only the appearance but also the function of the hand can be improved Whatever rotational deformity of the joints exists must of course be corrected at the time of closure of the cleft Where tendons are missing they may be corrected by some type of reconstructive procedure such as the Bunnell T operation (Fig 301)

WEBS One of the most common congenital types of derangements encountered in the hand are the so called webs For purposes of easy understanding of the extent of webbing of the hands the following classification is convenient Where a single web exists between any two digits the appendage is assigned the numeral I (Fig 304 top) Where one complete web exists between any two fingers and only a partial web exists between any other two fingers the condition is referred to as I plus If two complete webs exist between any three fingers and a partial webbing exists of any other two fingers the condition is referred to as II plus If only a partial web exists between any two fingers it is referred to as I minus Where all the digits are webbed except the thumb such a hand is referred to as III plus or subtotal syndactyli (Fig 305) Where the thumb is implicated with all the other digits it is referred to as Class IV or total webbing (Figs 306 and

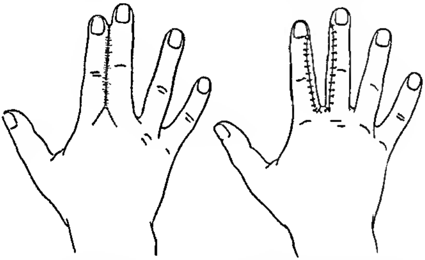


FIG 302 Method of incising closely webbed fingers with outline of interphalangeal flap In this type of web there is not sufficient tissue between the fingers to do a complete flap reconstruction Hence (*right*) a free graft (full thickness) is applied over raw areas between fingers

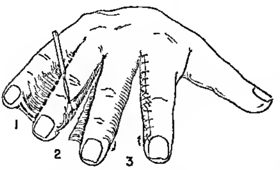


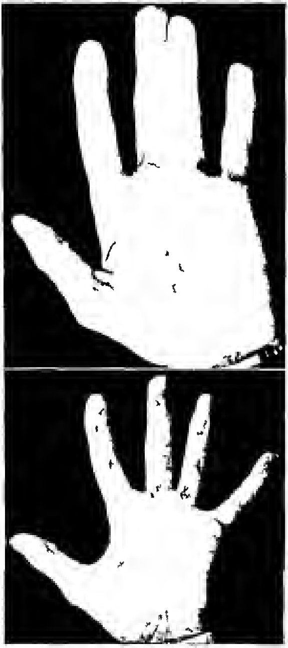
FIG 303 A method of separation of webbed fingers by web splitting procedure After splitting of web (1) a dorsal and ventral flap result (2) One is left attached to ring finger and draped around latter anteriorly whereas the other flap remains attached to volar aspect of middle finger and draped dorsally To avoid straight line closure both flaps and the respective normal skin to which they are apposed are slit at a 50° angle opposite the middle crease of each digit so that a Z closure can be accomplished (3) This obviates scar tension in the region of finger joints 1 2 3 illustrate basic steps in procedure

307) Where flexion deformity is present it is indicated as being of soft tissue origin bony involvement or both

The type of procedure best suited in the correction of these deformities is entirely dependent upon three things the extent of the web types of web and the extent of the bony deformity present Where the over all dimensions of the web are extensive enough some type of geometric separation of the web can be used in dissociating the afflicted parts of the extremity Where the web is short and thick only enough tissue may be present for the reconstruction of the space between the proximal phalanges of the finger This is a most important detail in the correction of syndactylism because without a well formed normal appearing interphalangeal space the appendage not only looks strange but good function and esthetic use of the hand never can be obtained In a narrow interphalangeal web considerable raw area will be left between the fingers after the splitting of the web It is better to free graft this raw area than to attempt a forced closure because the latter will only result in cicatricial distortion or recurrence of the web (Fig 302)

The two flap method of reconstituting an interphalangeal web (Fig 303) is adequate for the congenital type of web, but not always possible in the traumatic or cicatricial type In World War II as a result of the large number of burnt hands many cases of cicatricial syndactylism were seen One of the methods employed by some surgeons in view of the uselessness of scar tissue from the standpoint of reconstruction was to tunnel a split graft through the web at the normal interphalangeal level This tunnel graft was kept open by catheter or some other method After a lapse of three or four weeks the tunnel was slit open in the direction of the finger tips thus allowing for the separation of the digits with an ingrafted web Although this procedure allows for ultimate separation of the fingers, it rarely if ever, results in a good esthetic effect A far better result both esthetically and functionally, may be obtained by complete and immediate excision of *all* scar tissue between the fingers and full thickness free grafting of the entire interdigital defect This allows for better approach to leveling and angulation of the newly constructed web with much more nearly accurate apposition of the grafts and less scarring than in the case with the tunnel method The method is cited here simply because of its ease of performance and the temptation to use it in cicatricial webs It is contrary to basic tissue repair The disappointments which the student will encounter in the employment of such unphysiologic procedures warrants the inclusion of some and their discussion

Excesses TRUE EXCESSES Polydactylism is a tissue excess often seen by the plastic surgeon Such cases are extremely variable in their pattern Therefore no predeter



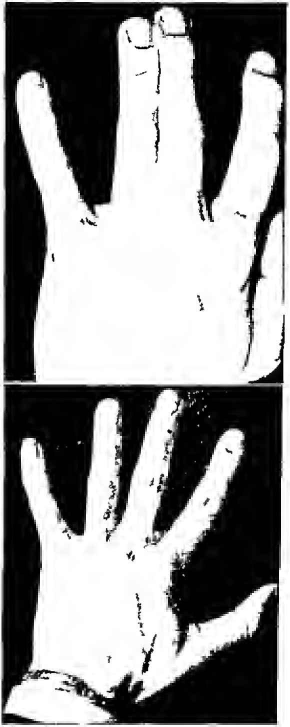


Fig 304 Complete plus one web of left hand (*Top left*) Single web of hand in adult with no deformity (*Top* year postoperatively (*Bottom right*) Dorsal view of reconstructed hand

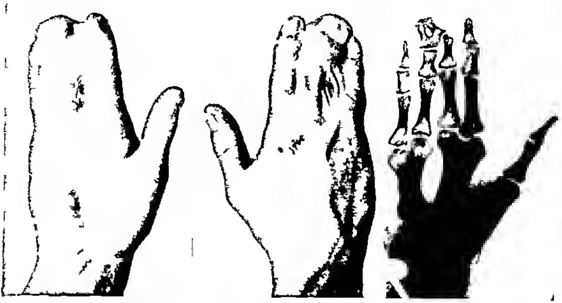


Fig 305 Complete plus 3 compound (bone) web of right hand (*Left*) Mitten hand (thumb excluded) with bone deformity (*Center*) Same dorsal view (*Right*) X ray showing bone deformity A one stage surgical correction was accomplished with sacrifice of tip of middle finger

mined plan of treatment can be assigned categorically Only the basic approach to the problem can be set forth

Before instituting any surgery roentgenographic investigation of the case must be done Next the presence or absence of tendons and muscles should be ascertained In the reconstitution of a good functional hand the supernumerary bones must be removed with due respect for the soft tissues present These may then be transplanted to the remaining fingers where necessary for improvement of function It is essentially a filleting operation with knowing redistribution of soft tissues As indicated above no strict surgical procedure can be outlined for these cases because of the almost unlimited variation in the distribution or displacement of anatomic parts (Fig 308)

A rather uncommon form of tissue excess consists of the hyperplastic giant overgrowth of a digit or several digits more commonly involving the phalanges and but rarely the metacarpals This condition is known as megalodactylia It is of two types that associated with bone overgrowth and that essentially composed of excesses of soft tissue The latter is an overgrowth of fat lymphatic and fibrous tissue ultimately giving the appearance of a digit which is tumorlike It is not unusual to find neurofibromata in the soft tissues suggesting credence of the hypothesis of Beveridge Moore that these conditions are basically neurotrophic Where there is little or no bone involvement the excessive amount of fat and fibrous tissue may be ablated by multiple excisions thus ultimately reducing the size of the digit Where there is bone involvement amputation may be the only logical treatment Bunnell suggests that the growth may be checked by destroying the epiphysis

False Excesses One of the commonest tissue excesses found in the hand is the so called *ganglion* It is a cystic structure usually multilocular most often located within the connective tissue in the prox

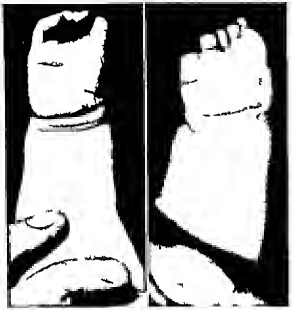


FIG 306 Complete plus 4 compound web of right hand (*Left*) Webbed hand without flexion deformity (*Right*) Same dorsal view

imity of tendon sheaths and joints Bunnell states that ganglia never communicate directly with the joints or tendon sheaths

One of the commonest postoperative difficulties with the treatment of ganglia whether by injection or excision is their recurrence This is usually ascribed to the inadequate removal of the ganglion The removal of a ganglion is looked upon as a simple procedure and therefore relegated to the inexperienced hands of the interne or the occasional operator

From the author s experience it would seem that the recurrence of ganglia is due to inaccurate knowledge of the anatomy of the structure Although the ganglion very often is a solitary structure it need not necessarily be so In fact if one takes the trouble to dissect out ganglia meticulously and particularly those of the wrist it will be found that upon the relatively long stalk which underlies the quite apparent cyst there may be two or more branching stalks each one of which may have another one or two small grapelike bodies at its terminus These may be removed quite some distance from the more apparent superficial structure In fact these branching stalks may entwine and involve tendons quite some distance away from the original incision (Fig 309) This results in a kind of branching structure where it is easy to remove the largest of the units and entirely overlook the smaller ones Following the removal of the mother cyst the others will grow and cause trouble Their subsequent removal is usually very difficult if not impossible because of the large amount of fibrous tissue consequent upon the first operation This is particularly true where the original operation has been done by inexperienced hands Such secondary operations may result in injury to tendon sheaths or even to the tendons themselves and so eventuate in tertiary operations often leading to functional impairment if not actual deformity From the foregoing it is obvious that the removal of ganglia of the hand should be done with the same care caution and meticulousness exercised in the performance of surgical procedures involving the most delicate structures of the hand

As tumors other false tissue excesses in the hand occur rather frequently although they are for the most part of the benign type Malignant tumors of the hand are comparatively rare and because of the ease with which they are discovered offer quick opportunity for their complete eradication and cure The benign tumors although rarely of an extreme size are of importance because a relatively small tissue excess interferes markedly with the function of the appendage These consist of fibromas lipomas and xanthomas chondromas fibrosarcomas and angiomas Their pathologic peculiarities are no different from those of like ilk elsewhere and their treatment is one of calculated incision complete excision of the lesion and functional closure

DISABILITY EVALUATION OF THE UPPER EXTREMITY

The question of disability evaluation of the upper extremity is of *particular interest* to the plastic surgeon There are several schemes and approaches to this important problem but none as yet seems to answer the question completely though most of them are satisfactory in general The schemes vary in that some are based upon *the evaluation of the upper extremity as* being 100 per cent apropos the body Others are based upon the idea of the extremity *per se as being 100* per cent and still others are based upon the concept that *the hand* being such a complicated and special part of the upper extremity, should be accepted as the basis of calculation in other words 100 per cent

FIG 307 Complete plus 4 bilateral simple (no bone path) webbing of hands (*Left*) Webbing of infant s hand with flexion deformity The child s extremity in this picture is held by the mother s hand afflicted by the same condition changed only insofar as a midline separation was risked in her childhood Under dorsum of mother s hand is visible one of the infant s feet with two perfectly formed big toes on each foot Hands and feet reconstructed in four surgical innings (*Right*) The hands of the 26 year-old *mother of the infant Both hands were separated by simple midline incision* in infancy Grandmother afflicted with identical hands and feet as infant and its mother one grandfather also had hand deformity

All the methods agree in one respect and that is that evaluation must be based upon the various factors and functions peculiar *to the appendage* as a *whole or that part of* it which has suffered injury In connection

with the hand this is based upon the functions of grasp, pinch, hook, and the function of feeling. The authors of these various methods are H. M. Kessler, E. D. McBride, D. B. Slocum, and others. Every one of the systems extant is based upon a preaccepted premise. That of Slocum, for instance, is designed upon an essentially orthopedic concept of the hand. It is a quite practical and generally satisfactory method, but not inclusive enough to be applicable in individual cases. With that reservation, it promises to be one of the most equitable methods of disability evaluation (Fig. 310).

The entire problem is well expressed in the words of Sterling Bunnell:

> Appraisal of disability in a hand should be based on loss of useful function. Sensation and motion are about equal in value. A hand without sensation to touch, pain, and movements of muscles and joints is devoid of stereognosis, protection against injury, and trophic control and is unfit for work.*

In connection with the systems of evaluation extant, Bunnell goes on to say that

> there is need for a standardized uniform system of rating throughout all the states. No system can be exact, for there are too many factors. Any schedule is bound to be arbitrary throughout, varying in justice for the individual case, but practical and satisfactory on the average.†

Bunnell summarizes the premise underlying all systems as follows:

> Most schedules have a small list of disabilities listing only total loss or amputation of each part of the hand. The disability is given in terms of per cent. The percentage of disability is expressed either as the per cent of total body loss, this being 100 per cent, or as the per cent of total loss of the arm, which in turn is rated at some percentage such as 60 of total body loss, or 100 per cent. In the latter case, if the loss of a hand is rated at 90 per cent, the percentage of such disability will be 90 per cent of 60 per cent or 54 per cent.‡

* Bunnell, S.: *Surgery of the Hand*. Philadelphia, Lippincott, 1944, pp. 602.
† *Ibid.*, p. 603.
‡ *Ibid.*, pp. 603, 604.

Partial permanent disability is figured as a percentage of that part of the hand which is partially disabled. If the injuries are mul

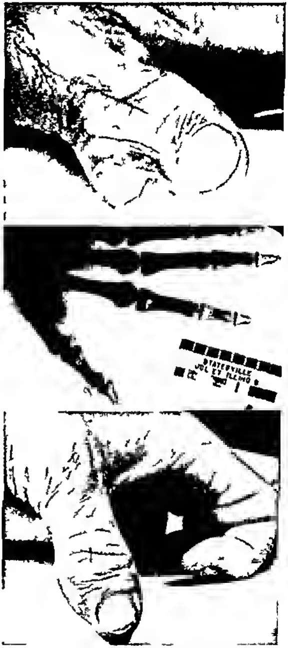


FIG. 308. (*Top*) A case of twin thumb. (*Center*) X-ray of same. Note that bony structure within supernumerary thumb is separate from main body of thumb. There was a rudimentary capsular structure between it and the major thumb. (*Bottom*) Condition 6 months following correction.

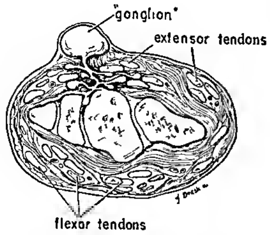


FIG 309 Anatomy of wrist ganglion Note grapelike small ganglia projecting from main stalk They are responsible for postoperative 'recurrences' The removed large ganglion per se does not recur

tiple the percentages are added, but they should not total more than the percentage for loss of the member As indicated the difficulties in the standardization of disability evaluation are many and the variables legion

Obviously, all the systems used in disability evaluation are basically quantitative and essentially structural They naturally tend to reduce all approaches to the democratic common denominator that a tooth is a tooth and a hand is a hand In other words that all hands or extremities, irrespective of the possessor or the peculiarities of his vocation and profession, are basically of the same value This, of course, does not anywhere nearly answer the problem of the value of an index finger in a renowned pianist as compared with the same type of loss in an architect or a plumber Likewise, where children are employed in industry, such evaluations find it difficult to assign satisfactory values to the loss of an index finger in a child as compared with an adult

Since the systems in use are essentially quantitative and basically structural—a strictly utilitarian premise—it would seem to the author that possibly a reversal of the approach, namely, a qualitative one, might be taken into consideration This of necessity would have to begin, not with the assumption that the body constitutes 100 per cent of the individual, or that the upper extremity or the hand per se be accepted as the percentile starting point, but rather that the nature and the extent of the injury be analyzed in terms of impediment of the various categories of function form and feeling as related to the over all import of the injury to the individual's social as well as economic position

An example in point might be the comparison of a professional violinist and a bricklayer both of whom had suffered the loss of the little finger of the left hand The violinist would cease to be a violinist whereas the bricklayer could still continue to be a bricklayer If the former only suffered loss of sensation in the little finger he would still cease to be a violinist whereas the bricklayer would find it a very minimal impediment to his craft The loss of sensation in the little finger of the violinist would be practically equal to loss of four fingers of the left hand in the bricklayer In other words, the quality of loss in the violinist can be paralleled with a rather extensive quantitative loss in the craftsman Finally if the bricklayer suffered a total loss of the hand he could still continue to be a fairly good bricklayer with an appropriate prosthesis, whereas no such advantage exists in the case of the musician With the loss of sensation in the little finger, it is quite true that the violinist could take up the craft of bricklaying and thus earn a living, but the difficulties of such a social and economic metamorphosis are obvious

The premise for such evaluation of disability is admittedly based upon a comparison of two relative extremes, and it is outside of the scope of this volume to attempt a method of evaluation, the suggested premise is only intended to impress upon

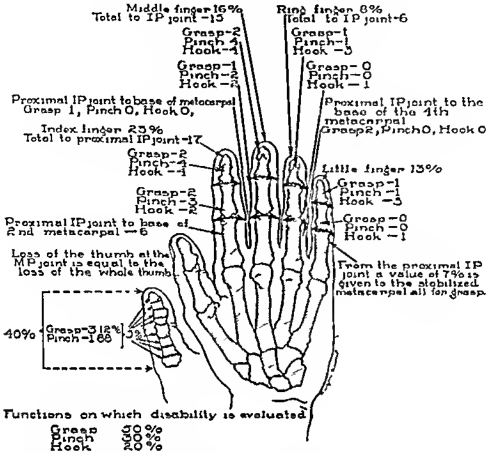


FIG. 310. Slocum's method of disability evaluation of the hand. Pain is evaluated according to the extent to which it interferes with each of the three major functions. Although pain is a subjective phenomenon, its results must be judged objectively. An exquisitely tender neuroma in the pad of the thumb, for example, could eliminate all pinch in the hand (30 per cent), affect grasp—through pain and awkwardness—so that the effective delivery of grasp would be only 10 per cent instead of the normal 50 per cent, and impair hook—due to loss of dexterity—so that its value would be only 15 per cent instead of the normal 20 per cent. This would result in a residual value of the hand of 25 per cent of normal.

Total loss of sensation is valued at 50 per cent of the part. Thus, a 50 per cent loss of sensation would be valued a 25 per cent disability of the part involved. In many instances, other disabilities are present. The rule is to determine the disability of the part on the basis of function; this is the value of the disabled part and is used to determine the value of loss of sensation. For example, the middle finger is normally valued at 16 per cent. If the finger has been amputated at the midportion of the distal phalanx, the value of the disabled finger is 11 per cent. Associated nerve injury may have resulted in total loss of sensation in the other fingers. Since sensation is valued at 50 per cent of the part, there would be an additional loss of half of 11 per cent, or 5.5 per cent. (Slocum, D. B., and Pratt, D. R.: Disability evaluation of the hand, J. Bone & Joint Surg. 28: 492, 1946.)

the student s mind the complexity of the problem The final intent is to bring home to the student the realization that the problems and aims of reconstructive surgery must be based upon more extended consideration than simple surgical substitution The ultimate goal of reconstructive and plastic surgery obviously would seem to be the adequate social psychological as well as economic rehabilitation *of the individual* as a whole Failing that J Barrett Brown s allusion to the average surgical reconstruction of a part as a surgical substitute becomes more than a mere form of expression Upon the student this imposes the realization not only of the complexities and the consequences of injury but the appreciation of the necessity for painstaking surgery unrelenting effort toward rehabilitation of the individual and further research

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29

The Lower Extremity

GENERAL

Plastic surgery of the lower extremity is essentially of orthopedic importance The proof of its import and relationship to modern orthopedics comes out of World War II During the war the orthopedist was not prepared by training perspective or experience to cope with the extensive and over all problems presented by gross injuries of the lower extremity Due to the large number of complex injuries of the lower extremity it became obvious that the early reconstitution of the soft tissues took precedence over the conventional mechanistic approaches to orthopedic problems

The orthopedic surgeon who neglects to become conversant with the principles and practices of plastic surgery relevant to complex injuries of the extremities is not prepared to countenance the adequate prosecution of modern orthopedics It is therefore incumbent upon the young orthopedic surgeon of today to become thoroughly acquainted with certain practices and procedures long the exclusive property of the plastic surgeon This implies a thorough understanding of the planning care and management of soft tissue repair of grafting and ablation of extensive soft tissue defects the proper timing of tissue transfer and finally the biologic and physiologic implications consequent upon the various methods of tissue transfer Without such knowledge he will find it difficult to cope not only with the modern requirements of extensive injury of the lower extremity and reconcile the technical physiologic and functional implications of tissue transfer but finally to effect adequate rehabilitation of the individual

VOIDS

What has been said in connection with total voids of the upper extremity applies in principle as well as practice to the lower extremity The cineplastic problem is much easier because the lower extremity is essentially a weight bearing appendage and not as obvious in the form of a prosthesis as the upper Hence the psychological problems of prosthetic substitutes in the former are fewer and more easily resolved

DERANGEMENTS

General derangements of the lower extremity are those consequent upon transverse myelitis complete paralysis and total third degree burns For the management of the latter see Chapter 20 The Surgery of Burns and Their Consequences as concerns the first see Decubital Ulcers in this chapter

Partial derangements are treated segmentally as in the case of the upper extremity (vide infra)

EXCESSES

Elephantiasis

A comparatively unusual condition which may involve the entire lower extremity occasionally and comes to the attention of the surgeon for relief is elephantiasis For our purpose it is only the late stage marked by extensive fibrosis of subcutaneous tissue and skin or the so called stage of irreversible edema which is of interest from the

standpoint of plastic surgery It is a condition marked by generalized interference with the lymph drainage of the lower extremity manifested at first by swelling of the ankles ultimately resulting in complete involvement of the lower extremity up to the buttocks and the inguinal ligaments It is an irreversible type of edema of the lower extremity because in its later stages there is such extensive fibrous infiltration of the subcutaneous tissue and skin and destruction of lymphatics The extremity becomes hard leatherlike and fails to pit on pressure

On the assumption that the lymph circulation of the muscles was at fault Kondoleon in the early part of the century devised an operation whose purpose it was to connect the lymph circulation of the deeper tissues with the more superficial for purposes of drainage hoping to remedy the condition by short circuiting the flow from within outward The operation consisted of excising segments of skin and subcutaneous fibrous connective tissue down to the muscles Sistrunk (1926) modified the Kondoleon operation by undercutting of skin flaps followed by excision of the lymphatic permeated subcutaneous tissues On the proposition that muscles have no lymph Homans condemned Kondoleon s operation and recommended excision of the fibrosed subcutaneous tissue and part of the skin The remainder of the latter is then placed upon the underlying muscles tendon sheaths or bone

Because the foregoing procedures are multiple stage operations time consuming and require prolonged ambulation and because according to Matas the skin is involved and at fault as much as the subcutaneous tissue Poth Barnes and Ross have recently devised a one stage procedure The operation consists of complete excision of all subcutaneous tissue and derma of the leg with the exception of a bridge of full thickness tissue left over the tibia connecting the ankle and the infrapatellar region Before complete surgical avulsion of this tissue and provided that the skin of the leg is in good condition these authors advise removal of the skin of the leg in the form of split grafts which are then reapplied in their original location The same authors suggest an alternate method in which the subcutaneous tissue over the tibia is excised at the first sitting through a long medial incision and the skin is replaced over the bone When the skin over the tibia has healed and a new and dependable blood supply has been established a second operation is performed in which the procedure described heretofore is carried out in toto Their report is based upon satisfactory results obtained in four cases (Fig 311)

The authors comment that the operation is disfiguring and is therefore not advised in early conditions or such as might become arrested without producing a disabling elephantiasis

Mowlem of England has gone a step further in the analysis and surgical management of elephantiasis He divides all cases into three groups (1) The early phase is identified by peripheral swelling partial obstruction soft edema little pitting minimal exudation of fluid on skin puncture and essential involvement of only the distal part of the extremity Treatment is by elevation rest and general care (2) The second phase is attended by marked edema usually of the major portion of the limb with ready pitting perivascular fibrosis tense shiny skin which weeps lymph upon slight injury evidence of infection and general affection of the patient Treatment is by the so called lymphatic pedicle consisting of a large axillo abdominal tube which is eventually transposed so as to run from the upper thigh over Poupart s region toward the axilla (axial direction) thus draining the inferior extremity of its lymph (3) The third phase is represented by the advanced case where the entire lymphatic system has ceased to function and the con

dition is irreversible except by total ablation of the involved skin and subcutaneous fat (primarily of the leg) and its replacement by free skin grafts

Either Phases 1 and 2 or 2 and 3 may co exist In such cases a relevant combination of the three treatments is recommended

[In view of the practical orthopedic import of discussing the lower extremity in terms of its parts the surgical differentials —voids derangements and excess—will be considered segmentally as in the case of the upper extremity]

THE SACRO ILIAC TROCHANTERIC (S I T) REGION

Voids The tissue voids sustained in the S I T region are usually those encountered in connection with battle injuries In civilian practice extensive tissue losses in this region are rare The tissue voids encountered here may be divided into extensive soft tissue losses without nerve involvement those with nerve lesions those involving loss of bone and decubital ulcers The decubital ulcerations are included here for two reasons (1) because they most commonly occur in the S I T region and (2) because of their relationship to severe orthopedic problems

The soft tissue losses sustained in warfare resulting in extensive scarring of the gluteal or trochanteric region as a rule are of comparatively minor functional import and relatively easily reconstructed unless attended by extensive bony loss Reconstruction is possible due to the presence normally of large amounts of elastic skin and subcutaneous tissue in this region which can be moved or rotated into adjacent regions following the excision of scarred defects If the tissues are not available locally a thoraco abdominal tube may be used as in general derangements (vide infra)

In the revision of defects in the S I T region the most important factor from the standpoint of function is that the designing of flaps to be shifted into surgical defects be done in such a manner that the suture

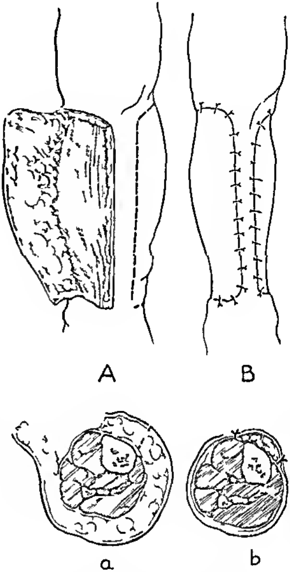


Fig 311 One stage procedure in the surgical treatment of elephantiasis (Poth Barnes and Ross) Two parallel incisions are made along tibia Their extremities are connected circumferentially about leg and all the skin and subcutaneous tissues are removed after split grafts are mobilized from this area The latter are replaced over raw area Subcutaneous tissue over tibia is removed some weeks later (Poth Barnes and Ross Surg Gynec & Obst 84 642 644)

lines do not cross the trochanteric area the anterior superior spine of the ilium or the sacrum This is necessary in order to avoid tender pressure points in connection with the wearing of apparel and belts and with reclining (Fig 312)

Soft tissue losses of the S I T region of an extensive character frequently involve the sciatic This may be only scar incursion upon the integrity of the nerve transection or actual loss of substance thereof In any plan of reconstruction therefore an evaluation of the condition of the sciatic must be included

Where the nerve is primarily involved by fibrous stricture the essential feature of scar tissue excision should be complete and meticulous freeing of the nerve In the performance of a neurolysis at least one of two allocating incisions should be made just outside the limits of the scarred defect one inferior to the scar and one superior to it The purpose of these is to allocate and identify a short segment of the uninvolved sciatic This reveals the important factor of depth and possible distortion of the involved segment Both uninvolved extremities of the nerve should then be looped with a strip of moist gauze

The fibrosed defect may then be circumincised and carefully dissected from the deep uninvolved tissues As the region of the sciatic is approached tension is made on the gauze loops placed about the noncomplicated segments The tension on the underlying tissues often reveals the course of the nerve through the depths of the scar

The scarred defect including the sciatic can thus be mobilized en masse After all bleeding is controlled and the depths of the wound dried thoroughly the scarred mass may be rotated sufficiently to extricate the nerve from its undersurface In old sclerosed defects this often makes the neurolysis easier and less hazardous in comparison with allocation of the nerve by direct approach through the outer and more sclerosed layers of the scar Control of scar oozing and nerve identification is usually more difficult when attempted through the outer sclerosed tissues

Once the sciatic has been freed and its continuity established an adequate bed must be prepared for it either by laying it into or wrapping it in a pedicle of fat Closure of the remainder of the soft tissue defect in these cases must be designed with the primary intent of adequate roofing of the nerve by flaps well cushioned by fat This may necessitate borrowing of tissue from the extragluteal regions Failing this no matter how exemplary the neurolysis the sciatic will be exposed to pressure trauma from sitting driving an automobile etc thus stamping the reconstruction as functionally wanting

Where bony injury or loss exists in defects of the S I T region although the case is basically orthopedic the same design of soft tissue repair must be followed before bone reconstruction is permissible For bone reconstruction of this region the reader is referred to current texts on orthopedics

Decubital Ulcers

The decubital ulcer until the advent of World War II and the stress laid upon its management during that period by the Surgeon General s office U S A was looked upon as a regrettable complication in cases usually terminating in death As a result of the experience gained in the management of these lesions during that period it was found that the decubital ulcer particularly in cases of transverse myelitis is amenable to operative ablation The problem at this stage is no longer one of mere nursing and topical applications

On the other hand the prevention of decubital ulcers is still a nursing as well as a dietary problem All precautions must be exercised against prolonged pressure on any one place in a patient who is bedridden Utmost cleanliness of the skin is advisable The maintenance of high protein levels in

FIG 312 Reconstruction of extensive soft tissue loss in the S I T region (*Top*) The depth of the wound precluded direct closure by local flaps because the filling in capacity of such flaps would not have been adequate Hence the large abdominal tube just above rim of the pelvis This was then jumped across the defect below the anterior superior spine of the ilium and more or less parallel with Poupart s ligament (*Bottom*) Repair completed Note adequate padding of trochanteric area and complementary Z plasty of femoral tissues to give good form to repair

such patients is inimical to the development of decubital ulcers

The surgical treatment of decubital ulcers prior to World War II resolved itself into cauterization escharing with tannic acid and occasionally free grafting Free grafting of the ulcer is inadequate except as a biologic dressing which will stand little wear and tear with bone as its background Hence since *John Staige Davis* report of January 1938 on the successful closure of scars following bedsores by the inshifting of French flaps after excision of the scar tissue the tendency has been to ablate all such lesions by this basic means (Figs 313 and 314)

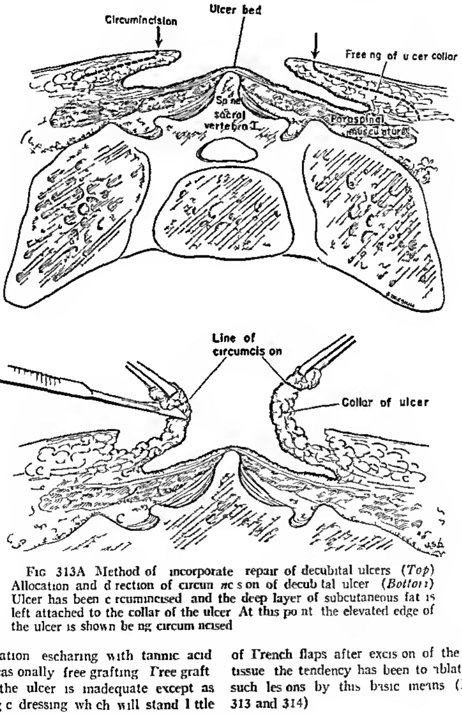


Fig 313A Method of incorporate repair of decubital ulcers (*Top*) Allocation and direction of circumincision of decubital ulcer (*Bottom*) Ulcer has been circumincised and the deep layer of subcutaneous fat is left attached to the collar of the ulcer At this point the elevated edge of the ulcer is shown being circumincised

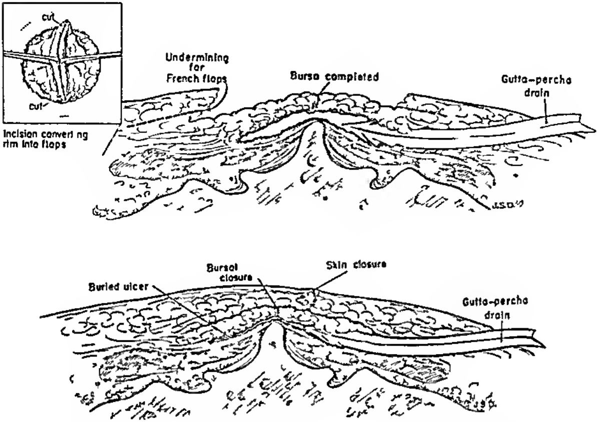


FIG 313B Method of incorporate repair of decubital ulcers (*Continued*) (*Top*) Construction of surgical bursa completed with gutta percha drain inserted Incisions for mobilizing flaps to cover the bursa are indicated by broken lines through subcutaneous fat (*Top inset*) Apposition of collar of raised decubital pouch prior to circumcision to show method of formation of flaps for roof of bursa (*Bottom*) Coverage of decubital bursa completed Note staggering of suture lines of collapsed surgical bursa and superimposed French flaps

The closure of decubital ulcers by the insh fting of collateral tissues in the form of French flaps is usually adequate in orthopedic conditions but fails to subserve the needs of a patient suffering with transverse myelitis This according to Donald Munro is due to a difference in the pathologic physiology attending ulcers found in transverse myelitis and ordinary bedsores This is based upon Munro s proposition that

it may safely be said under normal conditions that adequate supply of blood to the skin depends upon the integrity of two reflex actions which must include at least the spinal cord Failure of the reflex control of the cutaneous circulation when added to the local changes that have produced or will produce a pressure sore causes a bedsore to develop on this site *

The premise is not shared by all Munro goes on to say that

based on our knowledge of the deleterious effect of spinal shock on all reflex activity below the level of any spinal cord injury its presence immediately after the injury and its characteristic continuation or recurrence whenever exhaustion of sepsis develops I have assumed that the difference between ordinary pressure sore and the bedsore associated in any injury to the spinal cord exists because of the influence of spinal shock on the peripheral vasomotor reflexes †

One of the outstanding points of differ

* D Munro A consideration of bed sores New England J Med 223 322 335 1940
† Ibid p 335

ence in the ordinary or orthopedic bedsore and the decubital ulcer found in patients suffering with transverse myelitis as observed by the author has been the added change of color friability spotty discolorations and marked oozing in the subcutaneous fat of the myelitic cases Because of this many decubital ulcers in these patients although seemingly successfully ablated by the inshifting of collateral tissues sooner or later break down because of the liquefaction necrosis which takes place in the subcutaneous fat This is partly due to the obviate trauma to the overlying soft tissue and aid in the closure of decubital ulcers The procedure is applicable to a number of cases and unavoidable *in some* It is nevertheless and basically a destructive operation to be done as a last resort where otherwise irremediable bone pathology exists From a strictly reconstructive stand point the repair of one tissue or an anatomic part should not be *done at the* expense or destruction of the integrity of an adjacent part unless the latter is diseased or absolutely antagonistic to the

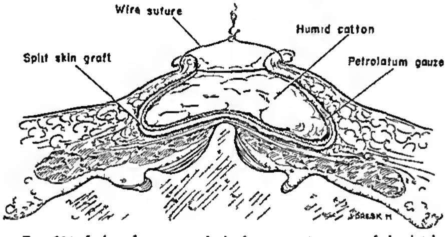


FIG 314 Fick s alternate method of incorporate repair of decubital ulcers Note free grafting of deep decubital ulcer in preparation for making of surgical bursa (Remainder of repair as in Fig 313)

fact that the subcutaneous tissue being the most easily traumatized tissue in the body will not subsist normal wear and tear when *shifted and laid directly against bare bone* *Normally nature always* interposes some kind of tissue between fat and bone or joint Usually this takes the form of a bursa Where this bursa is destroyed the subcutaneous fat overlying it tends to fibrose if its physiologic integrity is within normal limits Where this integrity does not hold the fatty tissue will liquefy and disappear

This has led some surgeons notably Kostrubala to resort to the radical excision of underlying bony structures such as the ischial rami and/or the head of a femur to repair of the former Finally in the case of decubital ulcers over the sacrum excision of the latter or any substantial part *of it is ipso facto out of the question*

Because of these observations and experiences with decubital ulcers in transverse myelitis the author has devised an operative procedure to circumvent the complication of fatty necrosis and liquefaction leading to ultimate return of the decubital ulcer The procedure may be carried out in one of two ways depending upon the general condition of the patient size of the ulcer integrity of the granulating surface of the lesion and whether or not bone is showing When the ulcer has an intact base when

the underlying bone is not presenting or in lected or does not necessitate trimming or removal and when the collateral tissues contain a substantial amount of fat the following technic is used

Method (Fig 313) The ulcer is circum incised through healthy skin to a depth of one half the thickness of the subcutaneous fat By gentle separation the deeper one half of the subcutaneous fatty layer is left upon the already undermined circumference of the ulcer When the extreme periphery of the ulcer is reached the circumference of the ulcer can be lifted and pulled centrally in the form of a roof thus forming a tissue pouch The base of the ulcer is left undis turbed and attached to the underlying bone

The abnormal epithelial rim of the tissue pouch is then excised leaving a clean edge of granulation tissue fascia and fat The rim is split at 6 and 12 o clock or at 3 and 9 o clock depending upon the polarity of the ulcer This results in two flaps

The granulation tissue of the ulcer is then swabbed with phenol or tincture of iodine the flaps are sutured together and imbri cated thus forming a kind of bursa of granulation tissue covered by a layer of subcutaneous fat Drainage is then insti tuted The bursa probably becomes oblit erated by fibrous tissue In the meantime it subserves an important physiologic func tion

The logic of superimposing flaps over the surgical bursa covered by fat (*thus bury ing the lesion instead of excising it*) be comes physiologically suitable and biologi cally tenable The actual designing of the French flaps must be dictated by the condi tions peculiar to each case

Alternate Method (Fig 314) When the patient is emaciated subcutaneous tissue is at a premium the ulcer is too friable or when bone is showing the lesion is first free grafted after removal of protruding bone After healing takes place the opera tion proceeds in the manner described ex cept that only a film of fatty tissue need be left on the collar of the reinforced ulcer This provides sufficient protection for the subcutaneous fat of the French flap against the trauma of the underlying bone The epithelial lined bursa may persist indefi nitely thus subserving an important func tion

Because these patients are bedded ven tralside down one of the most difficult factors in the maintenance of the repair is control of the pull of gravity upon the suture lines of the paralyzed hip girdle To exaggerate the importance of this detail from the standpoint of final healing is diffi cult Consequently the buttocks in these cases must be forcibly splinted in an exag gerated dorsal position for two to three weeks The inclusion of all other adequate postoperative necessities of management must be allowed

The above method is based upon its ap plication to 39 cases of decubital ulcer re checked after a lapse of from 6 to 22 months It involved the repair of 58 sepa rate lesions consisting of 31 cases of trans verse myelitis and 8 orthopedic cases All but 2 of the lesions repaired by this method have stood up under the stress and strain of use up to 22 months The exceptions (two partial breakdowns) were definitely due to the pull of gravity upon the buttocks

Derangements (Segmental) Derange ments of the gluteal region are often asso ciated with orthopedic conditions of the pelvis The ones of concern to the plastic surgeon are usually deforming scars which must be completely excised particularly if they occur in the lower regions of the gluteus and a meticulous repair done mainly on account of formative requirements Oc casionally other derangements of the gluteal region come to the attention of the plastic surgeon these are the result of previous surgical interference resulting in the de formity of the gluteal cheek When they occur they are usually associated with ex tensive loss of subcutaneous fat plus care less closure of the surgical incisions Their

revision must be planned so that the suture line does not cross the ischial tuberosities when the patient is in the sitting position This usually can be accomplished by placing the suture lines higher on the gluteal cheek than seems to be necessary

Where only as much tissue is needed to round out a gluteal cheek as can be supplied by a single flap, the latter may be brought over pedicled on the sacrum from the uninjured gluteus

GENERAL Reconstruction of the superficial tissues of an entire gluteal region may be accomplished by means of an extensive thoraco abdominal tube This is then swung down into position and may be managed in the same manner as employed by the author for total reconstruction of a breast (see Chap 25)

Excesses True tissue excesses in this region are usually those consisting of unusual deposits of fatty tissue These may be either congenital or metabolic Unless they obviously interfere with normal comfort and function surgery is not to be recommended When surgery is indicated, the student should bear in mind that all procedures dealing with the removal of large masses of fat in this region are not only a major surgical procedure but a definite physiologic problem Another detail to be kept in mind is that the excision of the fatty tissue must be done with the utmost gentleness and complete control of all bleeding It is not impossible for a patient to bleed to the point of shock into his own buttock after the removal of large masses of fat

False tissue excesses consist, in the main of lipomas and cysts Their excision is no special problem The incisions and closures should run with Langer s lines of tension, never across a crease and be consistent with weight bearing in the sitting position

THIGH

From the standpoint of plastic surgery, the tissue problems involving the thigh may be divided into three categories those affecting the tissues anterior to the femur, those affecting tissues posterior to the femur and those involving the knee region The first have to do mainly with contractures of the inguinal crease the quadriceps mechanism of the thigh and esthetic appearance The second has to do mainly with the integrity of the sciatic nerve and flexion, and the third with the function of the knee joint and the general integrity of the lower extremity as a whole

Voids The tissue voids of the anterior thigh outside of inguinal contractures result in greater functional disturbance of the lower extremity than almost any other From a reconstructive standpoint they are probably the most difficult to repair This is due to several factors the relative inelasticity and restricted amount of available tissue for repair and the difficulties of reconstruction of the quadriceps mechanism Whenever a gross tissue defect of the thigh occurs necessitating reconstruction tissue as a rule, must be imported from the contralateral thigh or the abdomen This is particularly true of war injuries in this region Where a tissue loss does not extend in depth beyond the femoral fascia this is not too difficult a problem But where the muscles of the anterior thigh are involved, reconstructions are not too satisfactory Since the latter is essentially an orthopedic problem the interested student is referred to works dealing with this specialty

The tissue voids which occur on the posterior surface of the thigh even though comparatively extensive are always much easier to repair than those occurring in the forepart of the thigh In fact, by the proper designing undermining and crossing of flaps obtained from the lateral and mostly the medial aspect of the thigh one is able to reconstruct such tissue voids sometimes to a surprising degree

One of the important types of soft tissue injuries are those involving the upper or

FIG 315 Reconstruction of extensive tissue void of thigh the result of a land mine explosion Sciatic nerve was not injured (*Top left*) Wound was immediately dressed by a thin split graft This left sciatic nerve frozen and subject to easy injury Pat ent was unable to tolerate even sitting pressure (*Top right*) Most of the lower and outer area of the split graft removed The skin and subcutaneous tissues of the medial and lateral thigh were extensively undermined A lateral flap was formed and incised so its lower half could be rotated medially as shown in the photograph (*Bottom*) At a subsequent operation further undermining of both medial and lateral aspects of thigh from the gluteal region down to the popliteal fossa was done This allowed for the des gning of several flaps one from the medial aspect of the thigh rotated across just above the popliteal fossa and two from the lateral aspect of the thigh the larger one of which reached across remainder of the thigh defect Fine stainless steel wire mattress sutures were used to stabilize the flaps The patient was able to drive an automobile without any sciatic irritation 5 weeks postoperatively

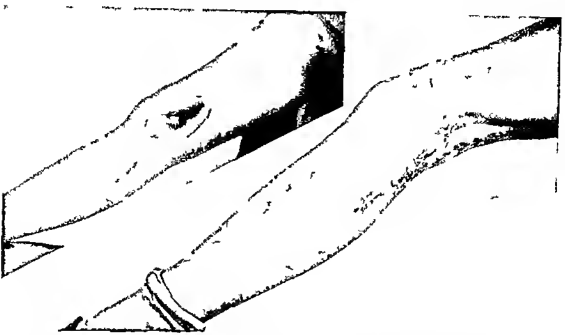


FIG 316 (*Left*) Through and through gunshot wound of lower end of femur with loss of entire condylar region and stiffening of leg Dark line around defect shows extent of excision as far as the joint The dark line on upper lateral third of leg represents lower half of anterior incision for bridge flap from posterior aspect of extremity to be shifted over defect (*Right*) Completed *one stage* dermoplasty Before shifting of flap *infrapatellar ligament was cut and patella rotated upwards into bony void and wired to* stump of femoral bone The raw surface on posterior aspect of extremity resulting from shifting of bridge flap was free grafted Patient was able to be up and about 5 weeks after operation (J F Pick Dermoplasty of War Wounds of the Lower Extremity J Internat Coll Surg 10 28-40)

subgluteal aspect of the thigh Extensive soft tissue losses in this region almost invariably result in some type of involvement of the sciatic nerve This may be the result of the formation of scar tissue about the nerve displacement and irritation or torsion of the nerve following healing and derangement of the soft tissues in this region or actual exposure of the sciatic Under war conditions the sciatic is then covered by a split graft and remains an area of irritation and trauma In the latter condition the original free graft must be completely removed all the scar tissue about the sciatic excised with adequate neurorrhaphy of the nerve and lavish covering thereof by substantial *pedicle flaps of good integrity shifted in and* across usually from the medial aspect of the thigh Where these are not available the tissue must be jumped across from the contralateral thigh or brought into place from some other region of the body such as the abdomen (see Voids of S I T region) *It is rather unusual to see a soft tissue void* of the posterior aspect of the thigh which cannot be repaired by collateral tissues In a well planned operation this is usually a single procedure in contrast with the multiple stage operations associated with importation of tissue (Fig 315)

The plastic revision of stumps is essentially an orthopedic responsibility In connection with revision of femoral stumps the important thing for the student to remember is that since the lower extremity carries the entire load of the body free graft repair

of a stump is basically contraindicated Such attempts are sometimes seen and often made by the neophyte in reconstructive surgery They almost invariably prove functionally inadequate even if surgically successful because even the full thickness free skin graft is rarely able to tolerate the load carrying responsibility of a femoral stump Wherever revisions are necessary they must be based upon the use of compound flaps of full thickness skin and subcutaneous fat Proper and careful shaping of the end of the bone even though this may necessitate additional sacrifice of the latter over and above the original amputation is a basic prerequisite to the conservation of the soft tissue repair

Where for cineplastic or other reasons it may appear to be a hardship to sacrifice any more of the femur that has been lost in the original accident or the first amputation a certain amount of soft tissue can be gained by prolonged skin traction at the end of the healed stump This traction should be applied wherever possible upon the soft tissues at the time of the original amputation or accidental loss

When closure or revision of an existing healed stump is done it is important to allocate the suture lines so that friction between them and the prosthesis is reduced to a minimum The ill advised placement of suture lines in a stump may make the task for the manufacture of the prosthesis difficult or even impossible This means secondary revision and useless sacrifice of tissue

Derangements of the thigh are for the most part of formative consequence except such as directly involve the quadriceps mechanism They are made up of nevi hirsutism pigmentations melanomas hernias aneurysms and scars The scars may be of functional consequence when they involve the groin or the knee joint All of them are more or less problems in excision and closure of the surgical defect The thigh like the neck or the lower abdomen is a region where partial repeated excisions are a profitable procedure Rather extensive involvement of the superficial tissues of the thigh can be eradicated by planned repeated excisions of the lesions followed by undermining (which can be quite extensive in the case of the thigh) and closure The best area for undermining is the medial surface

This applies to extensive lacerations as well as surgical excisions Where the laceration does not involve the underlying femoral fascia and muscles contamination is minimal infection is excluded primary closure of such lacerations is usually carried out with comparative ease after careful undermining In the closure of lacerations involving the proximal aspect of the thigh care must be taken not to infringe on the flexion crease in the groin Such a complication must be avoided even at the expense of additional operative incisions radiating from the laceration so as to permit or establish a polarity of closure consistent with the direction of the crease The same principle applies to lacerations on the posterior aspect of the thigh if the injury involves the popliteal fossa and the region about the knee This likewise applies to lacerations reaching up into or across the subgluteal crease Closures in the latter locale always must run parallel with the direction of the crease never across it

Excesses The tissue excesses involving the thigh region are for the most part of fatty origin such as excessively fat thighs lipomas and neurolipomas The removal of excess fat from the thigh is a major procedure not to be undertaken lightly It should never be attempted in one operation because of the danger of lymphostasis and venous blockage of the leg An excessively fat thigh is almost always associated with generalized adiposity and a particularly oversized buttock Hence where the operation is done for purely esthetic reasons it must be carefully planned so as not to end up with a formative monstrosity with acutely prominent buttocks If the operation is done at all the form of the buttocks

must be changed to comply with the reduction of the thighs The skin closures must preserve the gluteal creases and not infringe on the integrity of the anal opening All excisions are best accomplished by raising a flap the entire extent of the thigh with the primary incision placed on the medial aspect of it and pedicled laterally

With lipomas the problem is a simple one consisting of complete excision of the tissue mass with closure of the resulting incision Basically the same thing applies

Fig 317 False tissue excess (neoplastic) (*Top*) The large neurolipoma of left thigh was singled out for biopsy excision Its extent is shown by methylene blue outline (*Bottom*) Tumor is shown elevated from the femoral fascia to show entry of nerves into under side of the growth The lateral cutaneous nerve of thigh is clearly visible lying on the femoral fascia and giving off innumerable branches into substance of tumor held elevated by hooks (See Plate 13)

to the eradication of neurolipomas, except that, in the latter considerable dissection is required because of involvement of nerves or the underlying fascia (Fig 317)

Where excision of fascia is unavoidable and where this results in a comparatively long and narrow defect, this defect may be closed by direct approximation—if this can be done without tension and pressure upon the underlying muscle Otherwise the narrow fascial defect should be extended to avoid constriction of the herniating muscle or better still a dermic graft may be sutured into the defect to replace the excised fascia

KNEE

Extensive tissue voids of the knee region frequently are associated with the major blood vessels and nerves of the popliteal fossa the joint and not infrequently the upper pole of the tibia itself Where extensive injury to the blood vessels and the nerves is present this almost without exception necessitates amputation through the knee joint In extensive perforating wounds in this region if the nerves and the blood vessels are spared the joint and the lower portion of the femur may nevertheless be destroyed Following such injuries the joint is usually ankylosed and functionally irremediable Due to the loss of the lower *terminus of the femoral bone the entire* extremity is useless A protracted reconstruction follows if based on the importation of soft tissues to cover the scarred defect This is then followed weeks or months later, by some type of bone grafting to establish continuity between the femur above and the tibia below In certain cases this type of injury can be more expeditiously repaired by tissues about the defect The applicable procedure is a one stage operation including the establishment of bony communion between femur and tibia Basically it is a simple modification of the author s dermoplasty (See Dermoplasty of Leg in this chapter)

The type of case amenable to this kind of procedure is one where the defect is a perforating, one which results in loss of the lower end of the femur, without loss of the patella or vessels and nerves of the popliteal fossa

A posterolateral or posteromedian incision is made beginning at about the middle of the thigh region and extending down to the middle third of the leg All the soft tissues are stripped anteriorly until the free lower end of the femoral bone is exposed The patella is then freed The infrapatellar ligament is cut and the kneecap is rotated upward into the defect between the lower end of the femoral bone and the tibia The lower end of the femur and the upper end of the tibia are freshened and the patella is wired into position so as to establish continuity between the two The mobilized soft tissues are sutured anteriorly in their new position so as to cover the reconstructed bony continuity of femur and tibia This results in a soft tissue defect to the lateral or medial side as the case may be of the popliteal fossa This space with its blood vessels nerves muscles ligaments and fatty tissue is free grafted with a thick split graft The entire lower extremity is then placed in a plaster of paris cast until complete union takes place between the lower end of the femur the patella and the tibia *This obviously results in a lower extremity* without benefit of a knee joint but one which will adequately subserve the functions of carrying body weight and locomotion It is a one stage procedure which incapacitates the patient for a minimum of time and produces the maximum of functional results obtainable under the circumstances (Fig 316)

LEG

Tissue defects of the leg are among the most important forms of injury encountered in surgical practice From a reconstructive standpoint they can be difficult of management This applies particularly to the lower

third of the leg They not only range from voids through derangements to excesses but frequently are a combination of all three Defects in this region are common in both civilian and military practice They are usually of formative as well as functional consequence In civilian practice they may be congenital or traumatic in origin and not infrequently require extensive orthopedic intervention (Fig 318)

The principles and problems of Cineplasty were discussed in Chapter 28 and will not be reviewed

The soft tissue voids of the middle and the upper thirds of the leg are repaired with comparative ease by local shifting of tissue flaps (Fig 319) Prominent among these is the bipedicle or bridge flap Where the simple rotation of flaps into tissue voids in this region is not adequate, this may be augmented by the author's procedure based upon the reduction of the circumference of the leg by calculated excision of subcutaneous fat from the posterior aspect of the extremity (see Author's Dermoplasty, Chap 16, also Figs 116 and 117)

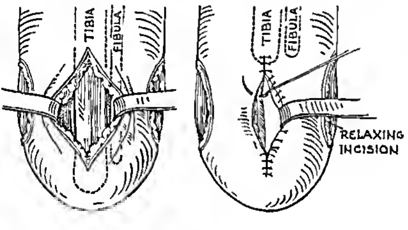


Fig 318 Construction of kineplastic stump of lower extremity (Kessler)

Surgery of the lower third of the leg is particularly difficult This is primarily due to the relative paucity of circulation and soft tissue coverage of the bony content of the lower leg Because of the small quantity and the nature of the soft tissues present in great part consisting of ligamentous and fascial structures, and the minimal circulation present, incisions and reconstructions must be planned cautiously and executed guardedly with a minimum of surgical trauma

Voids Tissue voids of the leg may be divided for convenience, into two classes those involving only the soft tissues and those with loss of bone substance

Dermoplasty of Leg

Method The description of the method will be confined to its application in the management of a compound fracture of the left leg, treated according to the open method, terminating in nonunion, ulceration absence of soft tissue over the tibia scarring, and unstable healing with deformity It is a procedure particularly useful and preferably practical on extremities with abundant subcutaneous fat If the wound is closed, dry and noninfected when the case is received, the 'preoperative care' immediately following may be omitted

Preoperative Care Given a leg with an

open ulcer, a culture is taken of its depths It is thoroughly scrubbed for one half hour or more and irrigated with saline The wound is then packed with gauze, mois tened with 1 per cent chlorazene solution or one half strength Dakin s solution Into the gauze pack is placed a rubber catheter, and the leg is bandaged over sterile dressings Through the catheter the humidity of the pack is maintained by repeated instillations of the chlorazene or of Dakin s solution for a period of three days At the end of that time, the dressings and the pack are re moved, and the wound is irrigated with saline It is dried gently, and a culture is taken

The wound is again repacked except that normal saline is substituted for Dakin s solution After three days the dressings are opened and another culture is taken of the depths of the wound Usually the wound is bacteriologically clean Should the bacterial flora be augmented the Dakin s solution is repeated for three more days If indicated one of the sulfa compounds or penicillin is administered

When the wound has shown definite bac teriologic improvement and is able to main tain it during any three days of the closed saline treatment a boric acid solution is substituted for the saline for an additional three days The case is then ready for surgi cal planning

Technically it can be attacked now in the same manner as a similar extremity without ulceration but with an unstable extensive scar over the location of the injury

The extremity is shaved and thoroughly scrubbed with soap and water 48 and again 24 hours before the operation It is then dried with alcohol and painted with tincture of mercresin or 0 5 per cent tinc ture of iodine Under sterile precautions it is wrapped in dressings

Preoperative Preparation The sterile dressings of the previous day are removed on the operating table The entire leg is again rescrubbed with soap and water It is

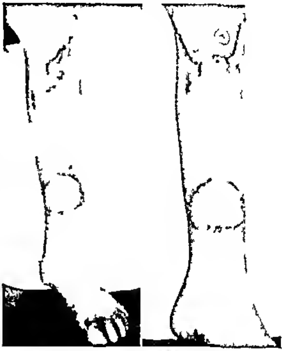


Fig 319 Coverage of tissue void of lower extremity by collateral tissues (*Left*) Whereas defect of lower third of leg had to be grafted by tissues from the contralateral thigh the defect of upper third can be closed by tissues in the vicinity (*Right*) Closure of defect of upper third of leg effected by advancing a flap from the region of the patella downward This was met by tissues ad vanced from the medial and lateral as pect of the leg

then dried with ether and painted with alcohol

Anesthesia The procedure is best car ried out under spinal analgesia If this is not available or is contraindicated the op eration may be done entirely under block and local infiltration with 1 per cent pro caine

Surgical Process

Step No 1 A washed transparent x ray film is laid on the defect be it ulcer or deforming unstable scar and an exact pat tern is cut of the outlines of the defect The pattern is then turned over to one or the other side of the defect through an arc of 180° The choice of the side of the extrem ity depends upon where the better quality

of tissue is available The film pattern is held securely against the leg, and its outer edge is indicated on the skin by a line made with aniline dye The exact area, or ulcer, to be excised is then outlined by dots of aniline dye

The skin around the ulcerated area is now penetrated, via previously raised wheals, by long hypodermic needles This usually requires a dozen such needles After these are inserted for their full length, 1 per cent procaine is injected gradually as a needle is being withdrawn (cf "Anesthesia," Chap 12) This is repeated until all the needles have been withdrawn and the entire surgical stage has been infiltrated

Step No 2 The defect is now excised carefully and completely In the case of an extensive healed but unstable scar, open excision, as illustrated in Figures 116 and 117, is practiced, whereas in conditions such as are shown in Figure 102, the open wound is first covered by gauze, which is then sewed to the defect This is done to avoid dissemination of ulcer debris onto the surgical stage The wound, including any bone protruding into it, is excised en masse, leaving a defect as shown in Figure 102 Every bit of pathologic tissue, whose presence would not leave a completely clean bed for grafting, is extirpated As in the case illustrated, a large part of the tibia, bare of all other tissue, protrudes into the wound Much of such bone must be removed in order to avoid leaving any sharp, bony prominences In other cases, all dead and sometimes bacteriologically unsterile bone is also removed It must be obvious that such a procedure leaves a very extensive surgical defect which cannot be filled satisfactorily by even a full thickness skin graft

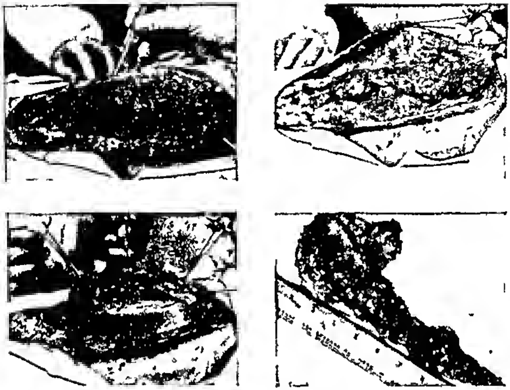
The aniline line previously drawn about the outer periphery of the film pattern is now converted into an incision This incision should extend in depth only about halfway through the subcutaneous fat, as shown in Figures 116 and 117 This is an important and necessary detail in the operation It is not to be construed as a simple relaxing incision, as will be shown presently, but as a specific dissective procedure whose ultimate objective is the repair of large tissue defects at low tissue cost This is made possible through shortening of the circumference of the leg by taking advantage of an anatomic detail

By very careful incision into the subcutaneous fat, a level is reached about halfway through its thickness, at which point it is quite definitely separated into two layers by a thin, transparent, membranelike sheath of fibrous tissue When this has been reached and identified, the adipose tissue is very carefully separated along this line in the direction of the defect If the exact line of cleavage in the fat has been allocated the separation usually can be accomplished with the gloved finger The obvious separation of the subcutaneous fat into two layers permits this part of the operation to be done almost bloodlessly The separation is extended throughout the area of the outlined flap and well into its upper and lower extremities This having been completed, there is created a double pedicle flap consisting of the entire thickness of skin plus a good subcutaneous layer of nontraumatized fatty tissue, enclosed by its own membranelike transparent sheath The flap has its own arterial and venous circulation, and most of its innervation is conserved Being completely undermined and freed under its extremities, it now can be moved in the direction of the defect so as to cover it

In a case in which considerable tibial bone has been removed even this bridge of tissue sometimes acts as only a roof for the defect whose depth is greater than the thickness of the flap At such times the import of the meticulous splitting of the subcutaneous fat under the flap becomes evident

The deep half of the subcutaneous fat serves its separate purpose at this point This fat, still remaining over the leg mus

PLATE 13



(*Top, left*) Exposure of extensive neurofibroma of left thigh Complete biopsy excision is preferential method in such lesions (*Top, right*) Neurofibroma completely isolated, showing nerve fiber communications with overlying skin (*Bottom, left*) Tumor avulsed to show course of lateral cutaneous nerve of thigh through its substance and giving off branches laden with fatty nodules at point indicated by hemostats (*Bottom, right*) Biopsy excision completed showing size of tumor

cles can be fashioned into one or several separate single or double pedicle flaps each one having its artery of supply and so employed to fill in cavities resulting from the removal of dead bone To have taken up all the subcutaneous fat with the skin originally would have made the bridge flap thick and unyielding in its transfer and would have prevented the necessary separate placement of pedicle fat flaps into the bone defects Pressure alone over the bridge of skin containing full thickness fat would not accomplish the same end The amount of pressure on the flap necessary to obliterate the dead space underneath would result in necrosis of the most vulnerable part of the tissue bridge its middle one third

Further question may remain as to the logic or feasibility of dissecting out only one half of the thickness of the subcutaneous fat The fact remains that since the deepest layers of fat contain the large and important blood vessels thereto and since the soft fat is always at the mercy of the relatively more rigid skin it becomes obvious that to force the deep layer of fat into any position that the skin bridge may have to assume is to invite angulation of the deep vessels and consequent necrosis of the fat

Where no deep crevices exist in the region of the tibia needing to be filled by flaps of the deep layer of fat the latter is sacrificed with meticulous preservation of the deep vessels This exclusion of tissue leads to the reduction of the leg circumference with relative augmenting of its skin coverage

In poorly nourished subjects not enough fat may be present to carry out this procedure in detail In others it may be necessary to delay the flap Such delay not only increases the circulation to the flap but also augments the integrity of its vessel so that the latter can stand more twisting and stretching without collapsing or obliterating Finally it should be noted that the inclusion of only half the thickness of the subcutaneous fat in the flap to be shifted over the tibia is far more consistent esthetically apropos the normal thinness of soft tissues over that region

Step No 3 The double pedicle flap having been properly mobilized can now be lifted and moved over the defect thus forming a bridge All hemostasis having been attended to in the ulcer-excised area the flap is spread out over the tibial defect and the far edge of it is carefully sutured to the normal skin

The shifting of the flap as can be seen results in a surgically unavoidable defect on the lateral side of the leg This is a new but easier problem than the original lesion It can be dealt with in several ways On the principle that primary closure is always preferable and more nearly ideal surgery it is well to reduce the size of the defect if possible and coincidentally to avoid the use of large free grafts This may be solved by reducing the circumference of the leg

Step No 4 To reduce the circumference of the leg the deep layer of adipose tissue remaining after the creation of the double pedicle flap is now carefully stripped from the underlying fascia of the muscle If the dissection is done carefully a very fine film of fat still remains on the fascia It is well to leave this behind It avoids traumatizing or buttonholing of the fascia and seems to be a better bed for the small free graft which may follow

Where the deep layer of the fat has been pedicled and rotated into the bony defect as indicated heretofore the shortening of the leg circumference is an inadvertent result

The removal of the deep layers of fat from the surgically created defect is usually sufficient in reducing the circumference of the leg to a degree permitting at least approximation of the angles of the defect This usually results in a 30 to 60 per cent reduction of the area depending upon the original thickness of the fatty layer and the elasticity of the skin

The geometric relationship between the size of the original defect, the surgical defect resulting from the shifting of the "bridge" flap and the small size of the free graft necessary to cover the residual defect, following shortening of the leg circumference, is shown in Figure 116J

Should the above excision of fat from the side of the leg prove to be inadequate for a material reduction of the surgical area, further removal of adipose tissue can be resorted to from the posterior aspect of the leg as illustrated in Figures 116 and 117 Decided care must be exercised in preserving the nerves and the vessels as they are encountered

In selected cases, one entire side of the leg may be stripped of all its fat, making it possible to close the surgical defect completely without any free grafting The procedure is rather time consuming if done with care It is recommended only in very extensive loss of skin, where too much time would be consumed in the importation of grafts as pedicles from other regions, or where such an amount of skin is not readily available

Step No 5 The surgical defect, having been materially reduced by approximation of its extremities, leaves only the problem of free grafting the residual surgical defect which, because it is a clean wound, is a far better bed for any kind of free graft than the original ulcer excised defect ever could be *The type of skin graft to be used may be* a matter of choice with the surgeon The author prefers full thickness skin [A word of caution In the reduction of the surgical defect, by direct approximation of the skin edges at its extremities, it never should be carried to a point where the suture tension is such as to produce distortion of the edges, or areas of tissue pallor The sutures will cut through, and nothing will have been gained but much will have been lost by a cruel effort]

A pattern is made of the small residual defect and laid over the skin of the thigh of the same leg The periphery of the pattern is outlined on the skin with aniline dye The skin included within this outline is then mobilized through its entire extent as a free graft The use of full thickness graft seems to be especially important where large areas need to be covered, since this gives not only better cosmetic but eventually better functional results Finally, because the afore-mentioned method leaves a physiologically ideal bed for grafting, one can resort to full thickness skin grafting with much more abandon

When suturing the free graft to the "bridge" flap, it is necessary that every occasional suture pick up the fascia underlying the flap One thereby splints the suture lines, insures proper tension and guards against any possible postoperative dislocation of the graft

One or two stab wounds are then made in the most dependent part of the free graft It is neither necessary nor advisable to make a sieve of a free graft by indiscriminate buttonholing It too frequently results in pockmarking Two well calculated and appropriately placed small punctures are sufficient The entire leg is now ready for dressing

Step No 6 In dressing these patients, a three inch wide strip of gauze, the length of the lower leg, may be glued to the back of it, either with collodion or some type of skin adhesive After doubling the edges of the gauze inward about a quarter of an inch, any number of sutures can be placed through the edges Later these can be tied over the dressing Under any conditions the "bridge" flap over the tibial region must have secure apposition to the tissues under it This is accomplished first by covering the entire operative stage with xeroform or 3 per cent scarlet red ointment gauze and then placing over this a sheet of sterile cotton, two inches in thickness, *sprinkled with saline* The cotton is then tightly pressed against the leg so that all excess saline is squeezed out of it Over this is

placed another layer of dry sterile cotton two inches thick which is covered by a large soft dry abdominal pad The entire combination is tied in place by the sutures formerly inserted into the gauze strip glued to the back of the leg The result is shown in Figure 117J The entire leg is then rolled in gauze bandage Following this a light plaster cast may be applied to the leg where transportation is necessary The dressing should not be changed prior to the ninth day

When the bandage is applied care must be exercised lest too much pressure be applied over the middle of the bridge flap It is possible to shut off its circulation at that point Elastic bandage is more prone than gauze bandage to produce constriction of the flap The reason is that as the saline moistened cotton dries and shrinks over the bridge pressure on the latter is reduced more or less consistently with the advent of postoperative edema A slow almost automatic pressure reduction results over the entire field with the use of gauze bandage due to shrinkage of the cotton not attainable with elastic bandages In the case of the latter while the cotton dries and settles against the grafts the bandage exerts more and more constricting pressure against a swelling bridge so that the circulation to a temporarily vulnerable flap is interfered with This is made only worse by any unevenness of the underlying bone Spot necroses will result in the flap over isolated bony prominences from the uncompromising elastic pressure of the bandage It is much easier to reinforce a loosening gauze bandage than to remove and readjust an elastic bandage

Postoperative Treatment The patient after being placed in bed has his leg elevated on a pillow The dressing including the cast is left undisturbed for from 12 to 14 days At the end of that time the cast and all the dressings are removed and the leg is inspected Usually it will be found that the full thickness graft is pink and that the bridge flap over the tibia is in healthy condition In well chosen and properly executed cases the flap over the tibia at this time looks and feels like normal tissue Even its temperature for the most part has been re established The sutures may now be removed and the leg redressed A single layer of petrolatum gauze is laid over the repair sterile dressings are applied and the leg is rebandaged The patient is then returned to bed for a week He is instructed during this time to indulge in limited controlled active movements of the leg

These patients other things being equal are ready for definitive orthopedic work 60 days after the dermoplasty Orthopedic entry is by a suture line of the bridge flap

The above method is applicable to moderately extensive soft tissue voids of the leg involving partial loss of the tibia with scarring which does not extend beyond the width of the bone Smaller tissue voids and particularly those of the upper third of the leg usually can be repaired by rotation or French flaps whereas very extensive tissue voids involving particularly the middle third of the leg can be repaired only in one sitting by an augmented procedure of the one just described This is based upon the same premises the cardinal one of which is the reduction of the circumference of the leg

Augmented Procedure Instead of making a parallel incision either on the lateral or the medial side of the leg the distance of which from the wound is equal to the diameter of the defect a vertical incision of indicated length on the posterior aspect of the calf of the leg is made (Fig 320) The subcutaneous tissue of the leg is undermined in both directions medially and laterally as far as the tibia in front or the defect involving the anterior leg The flaps are then replaced for delay for 12 to 16 days After the lapse of such time the leg is reincised posteriorly but this time to only the depth of half of the thickness of the

Fig 320 Deep sclerosed defect of middle third of leg the result of a gun shot wound There was considerable loss of tibial bone and fracture of the fibula Author s augmented procedure was ap pl ed through an adequate incis on on the back of the leg as shown reflected in m rror The skin and subcutaneous tissues were undermined in both direc tions up to the tibial defect and sutured back into position as shown Three weeks later tibial defect was completely excised The poster or incision reopened and the skin and subcutaneous tissue undermined as in the first operation Both were then advanced anteriorly and sutured together (See Fig 321)

subcutaneous tissue Where only a minimal amount of the latter is present all of the subcutaneous fat must be elevated with the overlying skin This obviously curtails the advantage of using the deep fat as fill in tissue which problem must be solved in some other way

This procedure amounts to a complete shelling out of the leg from its skin and subcutaneous investments One then has two enormous double pedicle flaps one medial and one lateral which after proper and very careful undermining can *simply* be shifted anteriorly over the tibia *and* su tured to each other The resulting surgical defect always on the posterior aspect of the leg is relatively large but being on the posterior surface it is less conspicuous (Fig 321)

Fig 321 Completed reconstruc t on of healed compound extens ve fractured leg Condit on as shown *3 months after* orthoped c re-entry of tibial suture l ne and bone grafting Note formative appear ance of leg Functional result was good The full th ckness free graft complementing poster or closure is seen reflected in m rror (See Fig 320)

As in the original procedure if only about half the thickness of the subcutaneous tissue was left on either one of the flaps the remainder of the subcutaneous tissue after approximating the flaps anteriorly can be carefully removed from the underlying deep fascia and discarded. This results in a reduction of the circumference of the leg which then permits reduction of the posterior surgical defect by direct approximation of the superior and inferior angles thereof so that the ultimate defect is appreciably reduced. The original surgical defect on the back of the leg can thus be

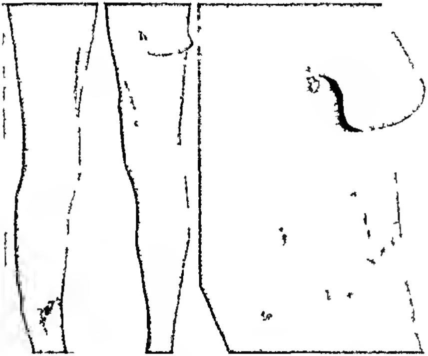


FIG 322 Examples of procedure in soft tissue reconstructions of the leg (*Top left*) Closed compound defect of lower third of right tibia by split skin graft (Same case as 109B) Final reconstruction based on "pincushion flap" seen hanging from left thigh (See Fig 113) Donor site closed by combined free graft and modified Z plasty on both medial and lateral sides of thigh (*Top right*) Close up of "pincushion flap" and method of closure of donor site (*Bottom*) Close up of position of injured extremity apropos pincushion flap on thigh (For construction of "pincushion flap" see Figure 9)

reduced by direct approximation from 20 to 60 per cent of its original size without interfering with the circulation of the extremity Whatever the size of the ultimate defect it is free grafted in the same manner as in the first procedure

This type of operation is a radical procedure It can be applied only to certain selected cases where the tissues of the leg are sufficiently well nourished so that in spite of careful dissection necroses do not result because of interference with the circulation of the flaps Where the case is judiciously chosen and the operation meticulously executed it is the most rapid way of ablating large wounds of the leg with far better functional and cosmetic results than are obtained by methods dependent upon tissue importation

The foregoing augmented procedure is not recommended for routine use by the occasional operator It is not a procedure to be done in haste or by the clock It obviously necessitates extensive dissection and carries with it certain dangers and pitfalls The cases chosen for this procedure must be selected with utmost care Due regard must be accorded to the circulation of the extremity its lymphatic drainage innervation general condition of the patient operating room facilities and means for adequate postoperative care

Tissue voids encountered in the lower third of the leg due to the structural peculiarities of this region do not share the same surgical advantages present in the upper two thirds of the leg Soft tissue voids in this region must be reconstructed almost routinely by the importation of tissues from the contralateral extremity or some other region of the body Only relatively superficial voids involving restricted areas of skin and subcutaneous tissue may be repaired by free skin grafting The remainder for the most part necessitates pedicle grafts which must be allowed to take root for longer periods of time than in the remainder of the leg before the pedicle is amputated and the soft tissue reconstruction completed Any bone grafting to follow such soft tissue repair must also be done later than in the rest of the leg in order to allow for adequate circulatory communion to develop between the soft tissue graft and the extremity Edema must be allowed to disappear completely so that organization of the repair and the condition of the extremity will have attained a good physiologic state before a bone graft can be risked To encourage the success of the latter it is wise in the transfer of pedicle flaps to this region to choose them on the basis of quantity of subcutaneous tissue present The flaps should be transferred with as much fat as possible to augment temporarily the vascular supply of this region A bone graft always will survive and do better under such a flap than under one with a meager amount of subcutaneous fat For reasons of form the fat always can be excised by secondary revision of the part but only after one is completely certain of the success and the integrity of the bony repair (Figs 322 and 323)

Derangements Those most often encountered in this region consist of extensive scarring of the anterior leg following osteomyelitis or compound fractures contractures involving the foot or the knee joint congenital constricting bands and varicosities

The ablation of simple tissue derange

FIG 323 Examples of procedure in soft tissue reconstruction of the leg (*Top*) The abdominal tube may be migrated to defect either via carrier such as the wrist or jumped *directly to the thigh of injured leg and waltzed down Circumstances determine choice of* procedure (*Bottom left*) Abdominal tube waltzed into position (*Bottom right*) Anterior view Completion of the repair consists of complete excision of underlying tissue defect unfolding of the tube and implantation If bone graft to tibia is necessary this may be done after minimum lapse of 6 weeks

ments over the tibial region may be accomplished by the methods just cited under tissue voids This extension of the dermoplasty is dictated by the fact that free grafts over the tibial crest do not stand wear and tear as well as the bridge flap The flap should be so positioned that the line of closure is to one or the other side of the crest of the tibia Where the site of scarring has broken down repeatedly prior to the operation the excision of the scar tissue must be done with caution and care so that reinfection of the underlying bone does not occur from any latent infection present in the scar This can be avoided to a large degree by proper preoperative treatment of the scar tissue and careful and adequate undercutting of it at the time of its removal so as not to open into the interstices of the scar with the possible release of any latent foci of infection into the depths of the wound

Contractures

Contractures involving the popliteal fossa may be resolved on the same principles as those discussed in connection with contractures of the elbow Contractures of the popliteal fossa except those of a vicious and high degree of *apposition of the leg to the* thigh can be resolved by the use of large thick split grafts over the popliteal area after complete excision of the scar tissue and release of the contracture The most important detail for the student to remember in connection with the release of such contractures is that none of the lines of approximation between the free graft and the tissues about the knee joint run in a continued vertical direction over the popliteal space Wherever this occurs one can expect some degree of postoperative fiddle string tension or even mild recontracture of the knee joint

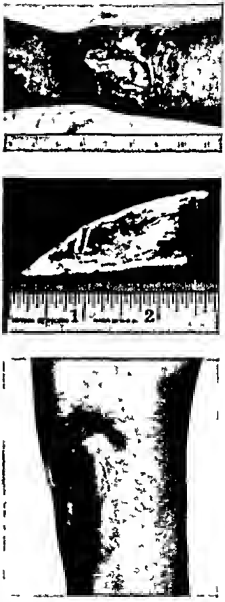
Contractures involving the ankle joint in contrast with the foregoing if they are of any depth must be released and reconstructed by some type of pedicle flap This is usually dictated by certain complicating underlying features of these contractures such as involvement of tendons or the ankle joints Hence after excision of the scar tissue responsible for the contracture bare tendon or even bone and joint may be exposed Such a bed is a poor recipient site for any kind of free graft Even if the free graft should survive it would adhere to the underlying bone and so result in a greater or lesser degree of functional involvement of the ankle This is altogether avoidable by the use of pedicle flaps which have even a moderate amount of subcutaneous fat under the skin The minimal formative deviation from the normal—contingent upon the use of pedicle flaps in this region—is negligible in comparison with the difficulties which may follow the use of free grafts In this connection a posterior flap from the other leg or the author s pincushion flap repair are methods of attaining desirable functional results (Figs 9 and *322 top*)

Congenital Bands

The exclusion of congenital bands of the leg is a comparatively simple procedure If they involve the entire leg circumference they should not be excised at one sitting Such a total and circumferential excision of a band particularly if the latter involves the lower third of the leg may result in interference with the circulation of the foot It is therefore advisable to do a hemilateral excision of the band at one sitting with structural repair of the soft tissues and final exclusion of the remainder of the band at a subsequent operation (Fig 324)

The simple excision of a congenital band and direct approximation of the soft tissues is inadequate for purposes of good formative results This is due to the fact that the tissues after approximation have a tendency to be drawn in a circular and constricting manner against the underlying tissues resulting in postoperative constriction of the extremity below the repair

PLATE 14



(*Top*) Compounded fracture of the tibia the result of inexpert attempt at setting a simple break in the bone, received 18 months after manipulation and "expectant treatment" (*Center*) Portion of proximal fragment of tibia removed Note screw inserted at time of manipulative accident 18 months previously, followed by forced closure (*Bottom*) Condition after late debridement with bone excision and free-grafting of surgical wound Patient made uneventful recovery, in spite of the removal of practically two and a half inches of the tibia, which regenerated spontaneously to such degree that the patient was able to walk without limping three and a half months postoperatively

Two things are necessary in the avoidance of this complication One is overcorrection of the surface repair by superimposition of subcutaneous tissues and breaking of the circular closure by a serial Z plasty The latter is preferable to a single Z plasty on one or the other side of the leg because it makes the resultant suture line less obvious This is particularly important where such repairs are done on female children (Fig 325)

Ulcerations are the commonest type of tissue derangements undoubtedly which come to the attention of the surgeon affecting the leg Until the advent of World War II these consisted for the most part of varicose ulcers As a result of the war the surgeon may now be faced with many other forms of ulcerations some of which are chronic burn ulcers ulcerations of scar tissue resulting from compound war fractures ulcerations of tropical and oriental origin and the ulcerations of chronic osteomyelitis

Although the contemporary tendency is rightfully away from the application of medicaments and in the direction of excision and free grafting the latter form of therapeusis is subject to abuse This abuse the result of misguided judgment in the application of free split grafts to ulcerations without thorough inventory of the condition of the extremity or the patient is a disregard of the fundamental principles of all rational and adequate treatment—the disregard of the underlying pathologic physiology of the ulcer This is becoming more and more evident in the recurrent ulcerations at or about the site of an original lesion There is no question but what the

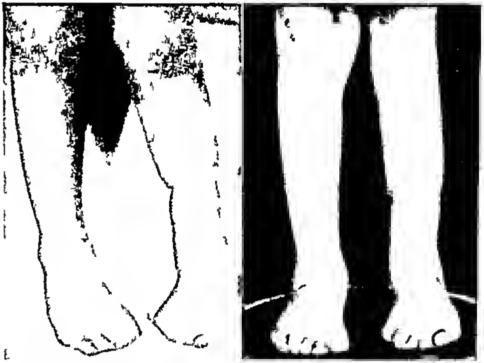


Fig 324 (*Left*) Congenital constricting band of the left leg Note associated webbing of toes (*Right*) Reconstruction of leg by 2 stage hemicircumferential excision of constricting band and modified Z plasty (See Fig 325)

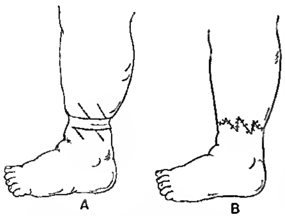


FIG 325 Two stage reconstruction of congenital constricting bands of extremity (A) Hemiexcisions of constricting band and serial Z plasty (B) Reconstruction completed

application of a thin split graft to a granulating clean ulcer is a rapid method of making a closed wound out of an open one Actually this does not mean any more than permanent biologic dressing of the wound It does not signify the cure of the condition responsible for the ulcer This admonition is risked to prevent the student from being taken in by the ease of ulcer ablation by split grafts only to be disheartened later by *recurrences All good surgical treatment* must strive for cure and not mere coverage of lesions which may be only local manifestations of a general condition This is not in any sense a devaluation of the importance of local treatment of the ulcer but rather a directive that treatment should not end necessarily with the surgical coverage of the lesion

Adequate treatment depends upon a thorough general examination of the patient proper evaluation of the pathologic physiology extant in the extremity and the institution of such general and local measures as are consistent with the findings Unless such a timeworn and established plan is followed the grafting of ulcers may prove to be a costly and disillusioning effort

Proof of the foregoing was eminently demonstrated by the early tendency in World War II of free grafting the many strange ulcerations which suddenly appeared on the surgical horizon among the injured returned from the Pacific oriental or tropical zones Almost immediate disillusionment followed this form of therapeusis because in most instances the graft would slough within a few days to a few weeks Not until the pathology of the then little understood ulcerations was known and adequate general measures instituted did *the grafting of such lesions find its proper* place

The most common ulcerations of the lower extremity are the so-called varicose ulcers The history and the evolution of their treatment is a long and involved one Only with the elucidation of its circulatory and mechanical background has any reasonable progress been possible insofar as insight into the genesis of the varicose ulcer may be of aid in proper timing of the grafting of such lesions is a short discussion pertinent

VARICOSE ULCERS

The varicose ulcer is the clinical end result of a vicious circle pathologically marked by all the local phenomena of chronic irritative infection with extensive fibrosis consequent upon a neglected circulatory inadequacy of the extremity essentially venous itself the result of congenital traumatic or infectious forces This entire picture begins with the varicose vein The varicose vein can be detected If detected early enough with appropriate treatment instituted the varicose ulcer has little chance of becoming manifest

The circulatory aberration giving rise to the varicose vein may be detected by certain simple tests The main purpose of these tests is to determine whether or not there is involvement of the greater or lesser saphenous system If the varicosities involve the former the testing of the venous circulation must be carried out from the groin to the ankle If they involve the lesser saphenous

system the tests proceed from the popliteal space to the foot Obviously, if both systems are involved both forms of testing must be carried on individually

The question of the patency of the valves in the superficial veins can in almost all cases be resolved by simply visualizing the mechanics of venous insufficiency which obviously connotes valve incompetency The next point for assessment is the integrity of the deep circulation After applying a tourniquet below the knee for the lesser saphenous system and at a level where the main saphenous trunks enter the deep circulation which is the upper thigh for the great saphenous the patient is then allowed to walk across the room If the tensity of the veins induced by the tourniquet lessens the deep circulation is patent Finally the integrity of the perforating veins must be established These may be located by certain tourniquet tests or by the venogram The tourniquet tests are all based upon the phenomena of backflow through the perforating branches when the superficial veins are excluded by the tourniquet (For details see monographs on this subject)

Normally the valves in these perforating veins permit the blood to pass only in one direction and that is from the superficial to the deep circulation But where the valves are incompetent drainage of the superficial area is inadequate or impossible and varicose distention of the superficial veins occurs The blood in such veins then tends to flow in a downward direction resulting in a venous overload stagnation and eventual ulceration This complicated by the almost unavoidable infection which follows leads to the establishment of a chronic condition calling forth local tissue reaction such as lymphedema protein precipitation in the interstitial spaces fibroblastic proliferation and finally extensive fibrosis This eventually leads to reduction or even complete exclusion of arterial circulation which results in ulceration and indolency of the lesion which in turn no amount of topical application will cure because of the cellular pathology surrounding it

At this point some form of surgery is indicated But at no time must the surgeon lose sight of the underlying circulatory condition of the entire extremity which it is usually impossible to remedy completely It is therefore the better part of wisdom to consider such a patient always a potential ulcer patient As long as the saphenous system remains demonstrably incompetent the individual must be made aware of the limitations of any form of surgery lest he be left with the impression that the closure of a varicose ulcer is a permanent cure of his leg trouble He should be instructed to return for immediate treatment of his condition whenever he notices any distended vein or tendency to edema in the foot or the lower leg

Many surgical procedures are recommended for the control of the circulatory aberration found in these cases These consist of injections ligation removal of strips of fascia to reduce lymphatic stasis removal of the saphenous vein and nerve, and lumbar sympathectomy The choice of any one or a combination of these must depend entirely upon the individual case its gravity and the conditions under which the surgeon labors Any importance in their application must be based on their value in the control of the general condition of the lower extremity Their relation to the surgery of the varicose ulcer per se must be measured in terms of their possible effect upon the pathologic physiology which they are intended to remedy Therefore the choice of any one of the procedures depends entirely upon this relationship

The actual surgical ablation of the ulcer itself may be divided into two types of approaches The choice depends upon the location of the lesion its size and extent its age and the general condition of the patient The first method is that of excision of the lesion and all of the surrounding pathologic tissues The adequacy of the excision must

be both in terms of depth as well as extent The surgical defect is then grafted If the excision results in exposure of tendons or bone it must be allowed to granulate for a period of from 9 to 12 days whereupon the granulating surface is covered by a split graft

The second method resides in the preparation of an appropriate flap or tube which may be transferred to the surgical defect immediately upon excision of the ulcer The latter method is more time consuming but *preferable in instances where excision* of the lesion results in exposure of tendons ligaments joints or bone Usually this procedure is indicated only in cases of extensive ulceration of the leg where it is of annular type with involvement of the deep structures

Where the free graft is used in the repair of varicose ulcers protracted postoperative protection is needed this must be impressed upon the patient lest injury to the graft result in recurrent ulceration and infection leading to even more extended surgical procedures later on In any case a patient with varicose ulcers should be followed periodically for a period of two or three years after ablation of the lesion

Excesses THE TRUE EXCESSES of the leg most frequently brought to the surgeon's attention are the *fat calf* and *thick ankle* The first may be approached on the basis of the author's dermoplasty with a posterior incision attended by careful removal of subcutaneous fat Where the large calf is due to large muscles not much can be done surgically The second or thick ankle condition is best left alone It is primarily due to a wide inferior third of the tibia and/or unusually thick ligamentous structures interference with which is a dangerous contemplation The application of constricting bandages over long periods of time are of no value

THE FALSE TISSUE excesses of the leg most commonly encountered such as infiltrating lipomas angiomas osteomas and other neoplastic growths are for the most part of general surgical or orthopedic interest and are seldom of immediate consequence to the plastic surgeon The deforming consequences of such lesions or those following extensive surgery on the extremity in connection with these lesions may result in situations necessitating reconstructive surgery

FOOT

Voids For practical purposes tissue *voids of the foot* may be divided into four categories plantar losses involving the toes plantar losses involving the heel those involving the arched dorsum of the appendage and loss of the great toe

Loss of the great toe is a major injury because it is important in propulsion of the body in a forward direction and because it has much to do with the maintenance of body balance Ultimately there develops a secondary involvement of the arch which may lead to complete deformity of the foot

Restorations of the great toe are based upon the same principles and similar procedures as apply to total reconstruction of the thumb Since weight bearing is the greatest factor in the former reliable bony union in the post type of toe is of paramount importance (see Chap 28)

Since partial voids of the great toe are not uncommon their reconstruction is of interest These may be accomplished in one stage by sacrificing the neighboring toe (Fig 326)

The scarred portions of the big toe are freed taking care that sufficient circulation is maintained in the remaining soft tissues The neighboring toe is filleted of its bone the soft tissues are pedicled in a manner suitable for apposition to the remains of the big toe The important point at this stage is to ensure the dorsal placement of the nail bed and the proper placement of the toe pad The bones removed from the good toe are shaped and immobilized against the metatarsal with two fine crossed wire pins

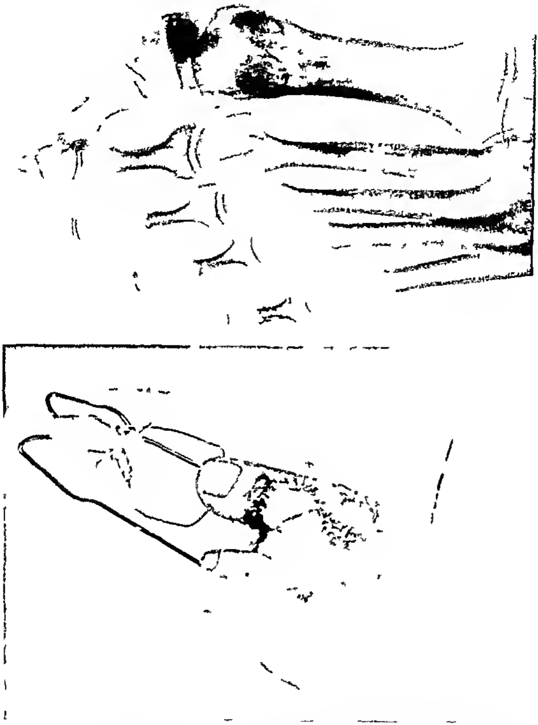


FIG 326A One stage reconstruction of subtotal loss of great toe (*Top*) X rays illustrating deformity due to bony and soft tissue loss of lateral aspect of big toe (*Bottom*) Compound reconstruction done by filleting adjacent toe and using its soft tissues and whatever bone necessary for big toe

The soft tissues are then sutured over the bone graft, as indicated above Pin traction is instituted for a period of from six to eight weeks

Loss of the heel and its functional consequences depends to a large degree upon cases as a result of secondary muscular involvement of the leg, makes such patients an outstanding surgical problem The latter is in the main due to loss of function of the tendo achillis

Total loss of the heel which is rather

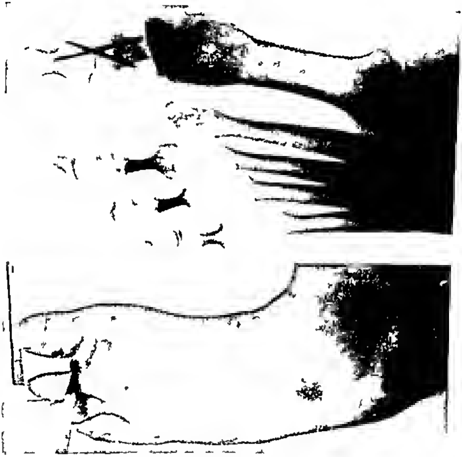


FIG 326B One stage reconstruction of subtotal loss of great toe (*Continued*) (*Top*) Postoperative x ray of compound reconstruction showing crossed pins holding postgraft obtained by filleted neighboring toe (*Bottom*) Completed compound reconstruction of big toe 9 weeks postoperative Patient able to walk comfortably Pencil points to region of sacrificed donor toe

the implication of the os calcis Because of the close relationship of the os calcis to the function of the entire leg the loss of the heel supersedes in importance the loss of the great toe Forward propulsion of the lower extremity is markedly interfered with the spring of the foot is extensively affected and subjective complaints in these unusual in civilian practice but not rare in war is one of the most complicated problems in reconstructive surgery There is as yet no adequate solution to the complexity of the situation from the functional standpoint A fairly good looking and useful heel can be made where the os calcis is not involved or only partially lost But where the

latter is completely absent no satisfactory reconstruction has yet been devised

In total soft tissue losses of the heel accompanied by minimal losses of the os calcis (even though the tendo achillis may be involved) reconstruction has a fair chance of good functional success

After replacing the soft tissues of the heel by tissue usually taken from a donor site covered by thick skin and used to weight bearing (such as the buttock), the tendo achillis may be substituted by a thick fascial graft and the lost bone by a graft taken from the ilium In one of the author s cases partial loss of the os calcis was replaced by a substantial cartilage graft taken from the costal area (Fig 327) It is a reconstruction demanding several procedures and an extended period of time, but, because of the functional importance of the heel to the entire lower extremity it is a worth while undertaking

FIG 327 (*Top*) Reconstruction of extensive foot injury consisting of partial loss of the sole of the foot with subtotal loss of heel (10 years post operative) (*Bottom*) Same plantar aspect

After the soft tissues are brought into place at least six months of simple weight bearing should be allowed before bony or cartilaginous grafts are inserted It is important at the time the soft tissues are apposed over the remains of the os calcis

that the latter be filed as smooth as possible Following completion of the heel, the patient must wear a sponge rubber pad under the heel for at least one year

The most common late postoperative complication in these cases is the tendency toward forward pleating of the skin of the new heel under the sole of the foot This may necessitate repeated minimal excision of the pleated skin until a permanent integrity of the underlying fatty tissue is established The pleating then stops

Tissue voids of the arched dorsum of the foot consist mainly of third degree burns and avulsions (Fig 328) (For the latter, see Chaps 20 and 38) In general, the management of full thickness skin losses of the dorsum of the foot may be repaired according to the principles and procedures indicated in the discussion of the dorsum of the hand (see Chap 28)

Derangements

SEGMENTAL In derangements involving only a portion of the sole of the foot, it is far better to attempt revision by shifting of the remaining tissues of the sole so as to cover the most vulnerable and functionally imperative sites of the underside of the extremity Such rotation of flaps on the sole of the foot may permit adequate functional reconstitution by ingrafting of the more silent areas which are normally not subjected to maximum pressure

In the latter category of derangements belongs the rehabilitation of the foot afflicted with perforating lesions Since perforating ulcerations of the sole of the foot still too often lead to amputation this may be avoided in many instances with proper planning Relatively radical excision of the perforation may be done, followed by closure via shifted or rotation flaps from the silent areas of the sole of the foot (Fig 329)

Where the foregoing is not possible because of the size of the lesion or the quality of the remaining skin of the sole of the foot, useful and functionally appropriate soft tissue can be made available by the deliberate sacrifice of one of the toes of the appendage By planned filleting of a toe a surprising amount of weight bearing skin can be rotated to the sole of the foot in the ablation of such lesions The loss of one of the smaller toes of the foot is never functionally as embarrassing or disabling as the presence of a perforating ulceration

GENERAL The tissue derangements of the foot that are of essential interest to the plastic surgeon consist mainly of scars and contractures involving the dorsum, and certain soft tissue defects or injuries of the sole of the foot The former are basically problems in scar excision and free grafting or the use of pedicles depending upon whether the elimination of the scar involves exposure of the underlying tendons and joints or results merely in a superficial skin defect Scar excisions of the dorsum involve the same procedures outlined for the dorsum of the hand Contractures of the dorsum are repaired by excision extension and flap coverage of the defect The shifting of collateral tissues over the arch of the foot is only feasible in relatively small defects In larger defects, the size of flap needed is greater than a rotation flap can cover It would necessitate denuding of the malleoli followed by the free grafting of the latter which is not satisfactory functionally or formatively

The involvement of the soft tissues of the sole of the foot is of pre eminent interest to the plastic as well as the orthopedic surgeon It may be said from the outset that the grafting of skin and subcutaneous tissue to the sole of the foot from other parts of the body can be very unsatisfactory This is due to the fact that there is no skin available anywhere else on the body, with the limited exception of the buttocks which is nearly equal to the weight bearing necessities of the sole of the foot It is, therefore, folly to employ free grafts in this region

Where the derangement of the sole of the foot is so extensive that tissue must

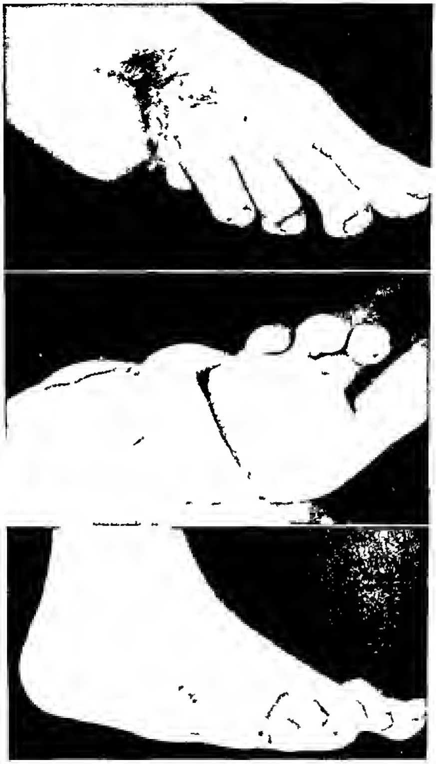
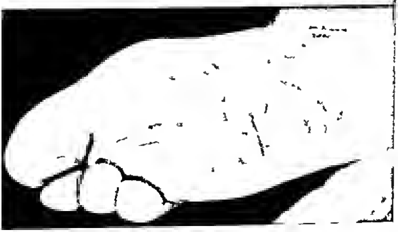


FIG 328 Compound tissue void of foot consisting of dorsal as well as plantar loss of tissue involving toes (*Top*) Dorsal view (*Center*) Plantar view of abdominal tube in position for reconstruction (*Bottom*) Lateral view of completed compound reconstruction 6 weeks postoperative



be brought in from other regions of the body it always should be in the form of a tube or a flap well supplied with subcutaneous fatty tissue The importation of such tissue with extensive fatty padding is the surgeon s only method of supplementing the weight bearing inability of skin from other parts of the body It is ordinarily only a makeshift for the structural difference between the normal skin of the sole of the foot and that found elsewhere The projection of trauma due to standing and walking through ordinary skin to the subcutaneous fat of a pedicle flap sooner or later leads to liquefaction or fibrosis of the fat resulting in shrinkage or disappearance thereof and ultimate exposure of the overlying skin to the underlying bone This sooner or later eventuates in ulceration of the skin and a breakdown of the entire repair Such an unwelcome result can be obviated to a certain extent in one of two ways

First of all the pedicle flap intended for the sole of the foot should be delayed deliberately several times before its final transfer to the extremity This accomplishes two things—an augmented circulation and a certain degree of fibrosis of the subcutaneous fat prior to its transfer so that the impact of walking upon the more superficial subcutaneous tissue will not be as acute The second method is to expose the newly reconstructed sole of the foot to very gradual use over a long period of time usually from one to two years before full and unrestricted use of it is allowed

Excesses

True tissue excesses of the foot consist of webs supernumerary toes gigantism of the big toe and others

The basic approach to the management of webs of the feet and polydactylism is the same as that pertaining to the management of similar conditions of the hand In connection with webs there is usually less opportunity of performing complicated flap operations by transposition because the webs affecting the toes are notoriously of minimal width The functional expression of the toes being of a much more simple character than that of the fingers makes simple separation with free grafting of any raw areas a procedure of adequate general application As a matter of fact the primary reason for operating on web toes is esthetic rather than functional

Gigantism of the toe is a comparatively uncommon condition It is marked by a tissue excess consisting both of bone and soft tissues In general its correction resides in partial amputation mainly of the distal phalanx and removal of the excessive amounts of subcutaneous fat and whatever skin seems necessary In this condition surgical intervention is done primarily for functional reasons

False Excesses The plastic surgeon is seldom called upon for the initial or primary treatment of warts of the sole of the foot As a rule when these cases come to plastic surgery it is because of complications occasionally arising in connection with other treatment such as x ray ill advised incisions which lead to cicatrices derangements or contracture deformity of the foot

A still commonly used treatment for this condition is the shaving of the lesion with the application of escharotics This is a slow crude painful form of therapeusis which has not much else to recommend it except that it is of historic interest

Superficial x ray therapy has been more

Fig 329 Surgery of perforating lesions of foot (*Top left*) Perforating lesion of sole of foot whose blind extremity lies under dorsal skin of foot Broken lines indicate area of excision Repair is indicated by dotted line rotation flap (*Top right*) X ray of perforating sinus of foot injected with iodized oil (*Center*) Lateral view of perforating lesion of foot injected by iodized oil (*Bottom*) Condition of sole of foot ten years postoperative All available subcutaneous tissue in the region of the defect was pedicled and rolled into depths of the wound (see text)

or less the treatment of choice in the past decade or two Fisher and Chamberlain in reporting a series of 315 patients state that their own over all cure rate with x ray treatment was 80 2 per cent They conclude On the basis of the data presented by this series of 315 patients it would seem that a single dose of almost any value from 1 000 or upward is as good as any of the more elaborate methods such as treatments at weekly intervals *

The same authors report on the use of Vitamin A in the treatment of warts in combination with x rays This therapy was begun on the basis of a personal experience of one of the authors who had suffered with a plantar wart for more than ten years who had had x ray treatments in 1929 and again in 1934 without success and then took a daily dose of 100 000 units of Vitamin A for three weeks whereupon the wart disappeared

Their method consists of filing the wart down vigorously with scraping afterwards until the lesion can hardly be palpated The patient is then instructed to use the callus file twice a day vigorously In addition to this he is given 100 000 International Units *of Vitamin A per day The patient is then* followed for a period of six weeks If after this time the wart has not completely disappeared and provided that there is no history of previous x ray therapy, he is then given roentgen treatments as indicated above

Quite frequently the posttherapeutic conditions consequent upon the treatment of warts are presented for remedying to the plastic surgeon Where the results of other forms of therapy consist of nothing but scarring the treatment obviously is one of complete excision of the tender scar with repair of the defect by a collateral flap and free grafting of the remaining raw area If a free graft is used for this purpose it is best to employ a full thickness type of graft Where the consequences of treatment are the result of the application of x rays this may necessitate wide excision of the affected area with importation of tissues in the form of flaps tubes or the filleting of a toe and the use of its soft tissues for the repair of the surgical wound

* S H Fisher and W E Chamberlain Roentgen and vitamin A therapy for the treatment of warts Pennsylvania M J 51 151 1947

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30

Face (Facioplasty)

GENERAL

The face as a unit is treated separately because of the many conditions involving it which only secondarily involve its separate parts particularly the orifices The reconstruction of general facial conditions may on the other hand affect the functional integrity of the orificial appendages directly Certain of these conditions (e g paralysis) have to do mainly with expression appearance or identity independent of involvement of any individual part or appendage but rather the integrity of the face as a whole

The facial afflictions belonging in this category are facial paralysis congenital hemiatrophy (Fig 27) wrinkles generalized carcinomatosis leontiasis ossea burns involving the entire face pox tattoos acne vulgaris lupus vulgaris and many others (for Dish Face etc see Chap 33)

Any or all of these conditions may affect any part or the entire face It is in the repair of these afflictions where appreciation of symmetry expression and proportion is put to the test These same conditions demand of the student not only knowledge of specific procedures but also an appreciation of the effect of the procedure upon expression appearance and identity

It is imperative to know that any extensive procedure upon any one part of the face almost invariably affects the appearance or even the integrity of at least the collateral parts of the face It is therefore incumbent upon the neophyte to recognize plastic reconstruction not only in terms of what might be adequate in unilateral repair of the face but how the attainment of bilateral results may be compromised by failure to temper enthusiasm with reason For instance in the operation of facial rhytidectomy it is seldom advisable to perform identical bilateral excisions of skin about the ears because the ptosis is not identical as a rule on the two sides of the face Even if it were the tissue elasticity on the two sides of the face varies sufficiently in most cases so that identical bilateral excision may result in detectable surgical alteration of expression or appearance

VOIDS

Total

A total void of the face in the true sense of the word meaning complete absence of all structures below the base of the skull and anterior to the great vessels of the neck is usually inconsistent with life In any case it is so rare except in warfare and so entirely complex from a reconstructive standpoint that a volume of this size does not permit of its adequate consideration

Partial

Partial voids of the face are those consisting of total loss of any one tissue like the skin or any one or more parts like the mandible and/or the nose Certain congenital clefts particularly those associated with absence of bone structure may be included under this heading The usual clefts are not actually attended by lack of tissue but rather a maldevelopment and are therefore discussed under Derangements in this chapter

The outstanding void involving the face

as a whole is the panfacial burn If the burn is severe enough it is unlikely that any type of surgery immediate or delayed will avoid the involvement of expression appearance and identity of the individual The treatment of this condition at that stage involves the total grafting of the face This is one of the major problems in plastic surgery (See Chap 22 The Full Face Graft)

The problems which are quite common both in civilian and military surgery are the voids suffered in connection with explosions injuries by sharp instruments or weapons bites and freezing The reconstruction of these voids is discussed in the appropriate chapters dealing with the loss of specific parts

DERANGEMENTS

Segmental

Local distortions displacements or misplacements of tissues of the face are discussed in chapters appertaining to specific anatomic parts (viz Orbit eyelids and Ear helix)

The outstanding derangement of the face is that consequent upon interruption of the integrity of the facial nerve This leads to so called facial paralysis which may be unilateral or bilateral It may be congenital or acquired It may be of central or peripheral location Etiologically it may be of neoplastic infectious traumatic toxic or psychic origin

The treatment of facial paralysis is entirely dependent upon its severity origin anatomic location of the lesion and lapse of time since the establishment of the paralysis

Whatever the origin of a facial paralysis it may result in inability to close the eye lids loss of facial expression ptosis of the affected side of the face and distortion of the nostril and the corner of the mouth on the affected side The ptosis of the cheek may be severe enough to precipitate constant biting of its lining and occasionally trauma to the meatus of the parotid duct

Insofar as the location of the lesion producing facial paralysis influences treatment this may be divided into lesions proximal to the stylomastoid foramen and those distal to the foramen The etiologic factors to be considered in lesions proximal to the foramen are mastoid disease inflammatory conditions of the geniculate ganglion and inflammations or organized hematomata in the descending portion of the Fallopian canal If there is persistent absence of response to faradic stimulation in lesions of the geniculate ganglion early decompression of the nerve is indicated Lesions of the facial nerve proximal to the stylomastoid foramen more properly belong in the realm of neurosurgery The stage of facial paralysis which more properly belongs in the realm of plastic surgery is when irremediable destruction of the nerve proximal to the foramen has resulted

In any case it is always difficult to be absolutely certain of the condition of the nerve within the canal even after its surgical exposure Unless an obvious segment of the nerve is missing it is not impossible that the nerve architecture belies its anatomic and functional integrity Notwithstanding where complete transection of the nerve exists and especially where a segment is missing it is more often than not a physical impossibility to do a direct suture The ingrafting of a segment of another nerve either by suture or biological glue in itself is a difficult physical task and remains a questionable operative venture on the whole

The second category of cases which feasibly belong in the realm of plastic surgery are the lesions and injuries of the facial nerve distal to the stylomastoid foramen The division is not entirely arbitrary It is based upon the fact that irrespective of the location of the lesion the paralyzed muscles need early support to prevent irreparable atrophy in anticipation of re

innervation Where there is any hope of the latter which at times extends over a period of up to two years it is absolutely necessary to give some kind of support to the muscles of expression This appertains in cases where resuturing or grafting of the facial nerve has been done but where function is not to be expected for a protracted period of time There is little consolation in the structural re establishment of continuity of the nerve and the reinnervation of muscles which have been allowed to fibrose In such a case one faces the paradoxical situation of having a good nerve but no muscle to work on From the standpoint of reconstruction it may be said that some type of interim support should be rendered to paralyzed muscles in the case of a repaired or grafted nerve whereas permanent support to the face is necessary where nerve function proves irremediable

SURGERY OF FACIAL PARALYSIS

The surgical management of facial paralysis may be approached in three ways by neurosurgery (nerve suture grafting or substitution) plastic surgery (fascial implantation muscle transplantation) or a combination of the two

Satisfactory nerve suture is usually feasible only in cases where one can do immediate or very early repair upon a cleanly severed facial nerve After the lapse of a few weeks and sometimes a few days there is so much retraction of the severed ends of the nerve fibrosis of the stumps as well as tissue intervening between the nerve stumps that allocation of the nerve ends is difficult and approximation becomes problematic because of the large void contingent upon freshening of the nerve ends It is possible of course by extensive dissection to reroute the nerve and so to compensate for the loss of its substance The relative severity of the operation in comparison with the more simple operation of autografting makes the former procedure far less desirable

As indicated heretofore autografting can be justified only by the presence of contractile power in the facial muscles Where autografting is indicated as is usually the case with involvement of the cranial VII in mastoid cases the injured portion of the nerve is exposed through a mastoid approach with removal of the posterior wall of the osseous meatus and exposure of the facial canal The damaged portion of the nerve is then excised Almost any sensory or motor nerve may be used as a donor source provided that it is of adequate size The lateral femoral cutaneous nerve is a good example in point After completion of the operation the bony defect is packed with oxycell or gelatine gauze and the overlying soft tissues are sutured The face on the paralyzed side should be supported in some manner to avoid overstretching of the facial muscles until such a time as recovery of function makes its appearance Until such time galvanic stimulation and gentle daily massage are advisable

As indicated above this type of surgery in facial paralysis should be considered as more properly belonging to the neurosurgeon or the hands of the expert otologic surgeon The procedure is mentioned here for the sake of pedagogic completeness Further technical discussions in this connection are to be sought by the student in appropriate texts on neurologic and otologic surgery

The ultimate consequences of injury of the facial nerve irremediable by direct attack upon the nerve are problems more pertinent to the work of the plastic surgeon It is here that the procedures of fascial implantation or muscular transplantation apply

As indicated in Chapter 23 Esthetic Surgery the so called sling operations popularized by Blair of this country are basically a supportive or prosthetic type of surgery Their primary purpose is to remedy the paralytic appearance This is accomplished by fascial elevation of the

affected angle of the mouth, the cheek and the lids

The fascia is usually obtained from the thigh in the form of strips four or five millimeters wide and long enough to reach from the temporalis muscle down to the corner of the mouth across the lip to the midline and back again to the temporal region The actual placement of the strips is as follows one strip leads from the temporalis across the affected half of the upper lip and back another from the same point of origin to the lower lip, across its center point and back, and the third strip to the corner of the mouth and back to the temporal fascia Some authors use the parotid fascia as a point of anchorage Others like Gillies recommend attachment of the fascia to the temporalis muscle proper in order to attain some degree of motion in the face via contractions of the former Where there is involvement of the eyelids a separate loop of fascia is employed subcutaneously encircling the aperture from outer to inner canthus

The fascial strips can all be inserted through a relatively small incision, just anterior to the hairline, which reaches down to the temporalis fascia or the muscle depending upon the chosen point of anchorage of the fascial grafts From that point on the fascial strips may be insinuated subcutaneously throughout the length of the cheek by a Blair needle or any instrument adequate to the task (See author's Fascia Guide Fig 141) The instrument is projected subcutaneously to the corner of the mouth At that point a small skin incision is made through which one end of the fascial strip may be engaged by the instrument It is then withdrawn so that the fascia is accurately on the flat and without any twisting pulled up to the temporal region The instrument is then reinserted through the original temporal incision but follows a path 3 or 4 millimeters to one or the other side of the original line of projection When it appears in the preoral incision again, the other end of the fascial strip is inserted into the instrument so that the fascial loop thus formed embraces a fair bite of the orbicularis muscle A similar procedure is carried out for the lower as well as the upper lip In this connection the fascial loops are placed in the midpoint of each lip (Fig 330) It is well at this point to chain the three loops of the fascial strips by a separate strip of fascia running from the middle of the upper lip around the affected corner of the mouth to the fascial loop in the lower lip, so as to stabilize the corner of the mouth, synchronize the pull of the three loops about the corner of the mouth and neutralize the outward evidences of insertion and pull of the separate fascial loops

This done, the three fascial loops presenting through the temporal incision and held in a hemostat, are tensed so that the paralyzed side of the mouth is elevated and placed into the position which seems most desirable This should be one of overcorrection the degree of which may be determined preoperatively as follows

The amount of normal correction necessary should be determined first by drawing a level horizontal line across the vermilion of the upper lip at the level of the unaffected corner of the mouth The amount of overcorrection can then be calculated by adding from 30 to 40 per cent of the distance from the paralyzed corner to the normal level indicated by the horizontal line It is advisable to do this preoperatively, because with the patient on the operating table the paralyzed corner of the mouth assumes an entirely different level due to the exclusion of gravity pull The overcorrection is necessary because in due course of time the fascial strips stretch This must be allowed for at the time of operation

Although the operation is seemingly corrective, it is not functionally satisfactory Even as a prosthetic procedure it is not always reliable The fascia does not always

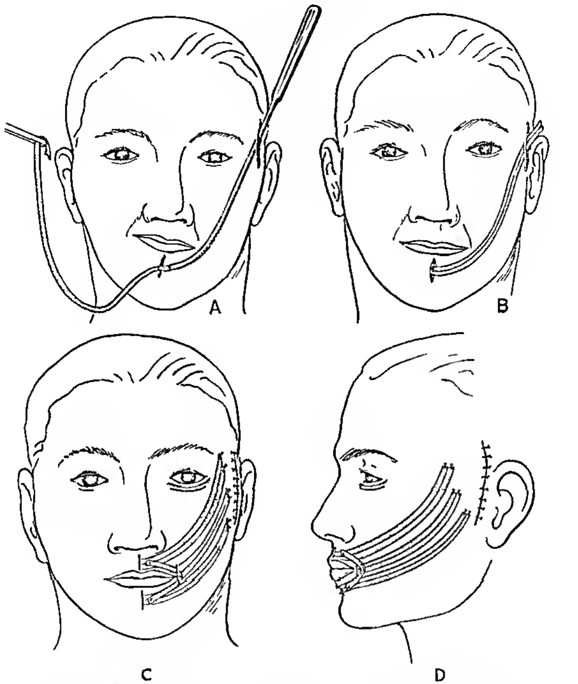


FIG 330 Sling operation for facial paralysis (Blair) This is a prosthetic type of correction which may be done with strips of fascia or derma It corrects the facial ptosis in only the resting position (see text)

hold as one would hope, or it may stretch to an unexpected degree Unless implanted at a proper depth and in a perfectly flat ribbonlike state, it may result in surface undulations or "ropy" appearance At times it is difficult to avoid infection which obviously compromises the results Eventual complete absorption of the fascia is not unknown, necessitating repetition of the entire procedure Finally, the amount of

fascia necessary particularly in bilateral facial paralysis is such as to create a defect in the donor site (femoral) inconsistent with comfort and good function of the extremity

Schuessler of El Paso has recently reported a case of unilateral facial paralysis corrected by the use of tantalum wire This was followed by Sheehan with a report of two cases and favorable comment The use of wire dates back to Busch (1913) and Momburg (1910) Other materials such as silk loops have been employed

Against the background of certain rigid premises and principles in surgery it is likely that the physical advantages resident in inanimate matter cannot ultimately compete with or supersede the use of viable material As for tantalum wire itself it is notorious *for late fragmentation* as *well* as considerable intolerance by moving tissue in contrast with its use in rigid bone

Because of the difficulties with fascia in the correction of this condition some surgeons have recently resorted to the use of dermal slings in lieu *of the fascia* The dermal slings are made available by choosing an appropriate area like the back where the derma is comparatively thick incising and dissecting back the epidermis for the required distance and then extracting the derma in the form of strips of adequate width and length comparable with the strips of fascia The dermal strips are then inserted in the same fashion as was described in connection with the procedures employing fascia lata

The author has had ample experience in *the use of ribbons of derma in this connec*tion The end results with derma are not as good as those obtained with fascia Derma has a tendency to stretch much more than fascia thus making it more difficult to determine the amount of postoperative descensus which will occur long after the operation Derma is much more liable to freeze within the subcutaneous tissue and stimulate fibrous proliferation about *itself than is the* case with fascia Because of the former circulatory communion with the surrounding tissue is excluded The derma thus eventually turns into fibrous tissue itself It frequently fragments and disintegrates early after operation The *chances of* postoperative subcutaneous infection are much greater with derma than with fascia because the former is more liable to carry saprophytic infection into the field of repair If the latter occurs it makes itself manifest many days or weeks after the operation in contrast with direct operative infection which occur within 12 to 36 hours postoperatively

Because of the foregoing difficulties in connection with the fascial and dermal support of the paralyzed face muscle transplantation procedures have been attracting increasingly the attention of surgeons These procedures are based upon the utilization of the masseter or temporal muscles or both Being innervated by the cranial V or trigeminal they are left unscathed in a true facial paralysis These operations are a *step in the direction of kinematic surgery* referred to in Chapter 23 Esthetic Surgery

Sir Harold Gillies of London was the first to reinstate the use of muscles in facial paralysis The sternomastoid had been used by Jianu Gomoiu and others the masseter by Jonnesen and Lexer the digastric by Jianu buccinator by Morestin and the temporalis by Eden These myeloplasties were practiced in the first decade of the century (1907 1911) and then were superseded by the inanimate wire in the second *decade The temporalis* has the advantage of being able to supply muscle fibers for the paralyzed eyelids which for mechanical and physical reasons it is not possible to bring about by the exclusive use of the masseter

In the use of the temporalis an incision is made above the zygoma down to temporal fascia Three ribbons of the temporalis with its fascia are then mobilized and left

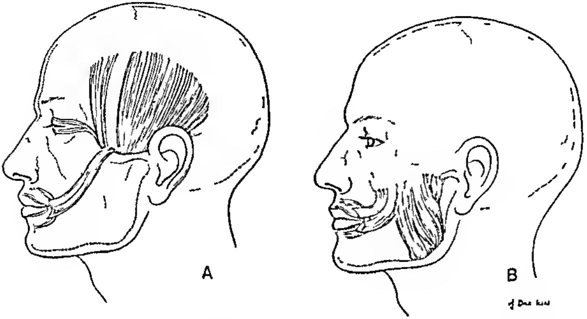


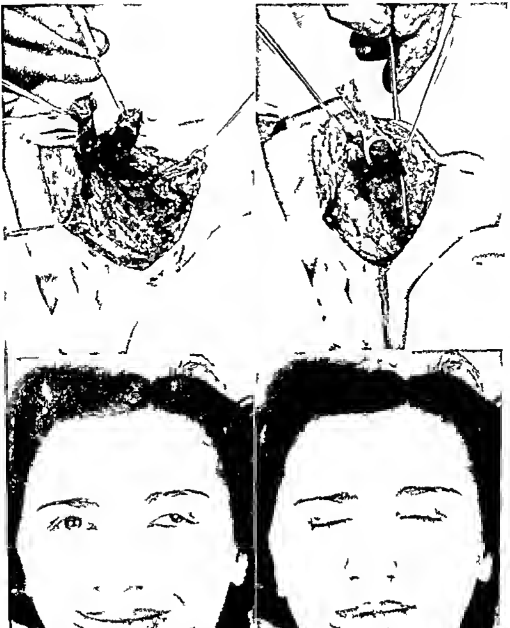
FIG 331 (A) Method of using temporalis muscle in facial paralysis (Gillies) (B) Correction of paralysis by transplantation of masseter muscle (see Fig 332)

pedicled on the inferior insertions (Fig 331) One of these ribbons of muscle is destined for the corner or the angle of the mouth and the other two somewhat smaller in diameter for the eyelids These reach their destination via a subcutaneous tunnel through which they can be guided by heavy nylon cotton or silk suture When the muscle ribbon destined for the corner of the mouth is turned down it usually leaves a bulge under the skin and over the zygoma This can be avoided by notching the zygomatic bone under it The two muscle slips—passed through the affected lids one through the upper and one through the lower—are sutured together into the underlying deep fascia in the region of the inner canthus

Where the slip of temporal muscle intended for the angle of the mouth is for one or another reason inadequate in its reach Gillies recommends covering the raw outer aspect of it by a fascia lata strip long enough to reach not only the corner of the mouth but to extend subcutaneously over the upper as well as lower lip somewhat past its midpoint A slight modification in detail of this procedure eventuates in somewhat better functional results This consists in attaching a strip of fascia lata only to the terminus of the temporal muscle to make up the needed distance between the angle of the mouth and the mid points of the lips This modification is thought advisable because where the fascia lata completely covers the ribbon of muscle turned down the muscle fibers do not establish as early a circulatory communion with their environment It is therefore not unusual to find that where the muscle is entirely covered by fascia lata much of it undergoes fibrous degeneration and shrinkage before adequate circulation is established throughout the part of it immediately subjacent to the fascia

Where the masseter muscle is used for kinematic rehabilitation of the paralyzed face an incision is made along the lower border of the mandible with a slight curve upward around the angle The muscle is identified and sufficient of it detached from its mandibular insertion so that two ribbons of approximately three eighths inch in diameter can be made These are then tunneled

subcutaneously to the angle of the mouth where the most anterior masseter pedicle is sutured into the orbicularis of the upper lip and the second pedicle into the orbicularis of the lower lip just past the angle of the mouth. This of course as in the case of the temporalis or the exclusive use of fascia is only done after the angle of the



mouth is pulled into its overcorrected position (Fig 332)

Where the masseter is small or undeveloped and sufficient substance is not available for both lips only one slip of muscle may be taken from the masseter for the lower lip Another pedicle of muscle for the upper lip may be mobilized from the temporalis

Although the myeloplasties are usually more satisfactory than the exclusive use of fascia they are by no means the final answer to the problem of facial paralysis The muscle corrections of facial paralysis have certain outstanding drawbacks They are in a sense mutilating operations in that they result in at least partial infringement upon normal muscle function They are more liable to result in extensive hematoma formation than is probable with the careful use of fascia In the case of the masseter muscle there is the danger of injury to the parotid duct or the innervation of the muscle itself The latter applies as well to the employment of the temporalis This of course can be avoided by meticulous surgery The muscle operations on the other hand have certain distinctive advantages over the fascial procedures When successful there is sufficient kinematic improvement of the paralyzed face to warrant their use The decision to do a myeloplasty for facial paralysis must be based upon the expertness of the operator the integrity of the muscles and the ultimate needs of the patient

Since none of the operations described in connection with facial paralysis is wholly adequate they should be employed selectively But since the paralytic condition of the face is so obvious disfiguring and annoying to the patient every effort is deserving which promises even fair results When properly applied they merit indulgence because the results obtained do so much for the comfort and the appearance of the patient

Whatever procedures are employed in the rehabilitation of the paralyzed face some external postoperative support is indicated for from 10 to 30 days after operation This is most easily accomplished by running 3 one half inch strips of bandaging gauze over the location in the direction and to the extent of the fascial or dermal strips whichever the case may be as a temporary complementary support until healing takes place These gauze strips are glued to the skin in their entire extent with collodion This method is far more dependable than the use of ordinary adhesive strips particularly during the summer months and in patients who perspire freely

HEMANGIOMAS

The generic term hemangioma is applied to commonly observed conditions of the face often referred to as birthmarks strawberry marks or port wine marks These are most common in childhood According to Forrest Young children constitute about 80 per cent of those afflicted

Fig 332 Transplantation of masseter for correction of facial paralysis (*Top left*) Exposure of the masseter and mobilization of two muscle pedicles from its anterior border each about ⅜ inch wide The outer pedicle is inserted into the orbicularis of the upper lip the inner pedicle into the orbicularis of the lower lip (*Top right*) Course of muscle pedicles after approximation to the orbicularis oris The surgical instrument seen in the wound inserted to show direction of subcutaneous tunnel from corner of mouth to region of masseter The exposure in this case was augmented for purposes of illustration (*Bottom left*) A case of dissociated facial paralysis corrected by masseter and temporalis transplantation This patient suffered a right lower facial paralysis at the age of 3 coincident with paralysis of the upper and lower left eyelids Note small incision under right corner of mouth which is point of approach for subcutaneous tunneling in direction of right masseter Observe balanced excursion of corners of mouth (*Bottom right*) Shows ability to close both eyes equally 2 months postoperative

They may or may not be present at birth If they are not present immediately after birth as a bluish or reddish blotchy dis *coloration of the facial skin* they appear within a few months thereafter as highly colored blotches which may or may not be elevated above the surface of the normal surrounding skin

They are usually divided into three types the capillary or port wine stain variety the hypertrophic endothelial hemangioma and the cavernous hemangioma The capil lary type varies in size from that of a pea *to the entire area of the face* The hypertrophic type is usually bright red and elevated above the surface of the normal skin with granular bright red undulations or excrescences The color does not change materially on pressure It is basically a true tumor microscopically exhibiting cellular growths often within and sometimes under the subcutaneous tissue consisting essen tially of endothelial cells These eventually obliterate the blood vessels in the vicinity and continue to proliferate into masses of endothelial cell groups This is the most common type of hemangioma and is often seen infected and ulcerating whereafter it *may metastasize to the internal organs*

The cavernous type of hemangioma is made up of large blood spaces lined by endothelium which early in life may be seen as distended capillary channels which continue to break down forming large blood filled spaces which communicate with the general circulation They sometimes re semble deep varicose veins and may occur anywhere in the body including the mucous membrane muscles or bones

There is no one treatment for hemangi omas The various therapeutic approaches to their treatment are carbon dioxide snow ultraviolet irradiation with blistering injec tion with boiling water or sclerosing solu tions x rays or radium electrodesiccation electrosurgery cover marl applications Grenz irradiation or surgical excision and grafting The latter may consist of a one stage procedure or repeated partial exci sions In very young children watchful waiting may be practiced but it may be risky

It is obvious that from the above array of therapeutic measures recommended that there is no final standardization of approach to the problem Hence there remains the necessity for intelligent and selective appli cation of the various methods available

The basic criteria which determine selec tion of the best form of therapy are the type of lesion its location and the age of the patient From a practical clinical stand point this may be summarized by saying that the younger the child or the lesion or both the more conservative the treatment may be provided that there are no signs of rapid extension or malignancy the older the individual or the lesion or both the more formidable the therapeutic approach has to be particularly where any cellular activity is discernible

A fourth factor in the treatment of these conditions which is very often overlooked is the importance of the expertness of the therapeutist More damage can result from the application of the simple method by in*experienced* hands than the employment of a more radical therapeutic procedure by the expert Finally an intelligent combination of various methods over a period of time usually gives the best final results

Treatment Planning

Reducing the modern treatment of he mangiomas to a common denominator it may be outlined in the following way Assuming that the hemangioma is detected in infancy expert topical application such as blistering with ultraviolet rays ablation by carbon dioxide snow radium or possibly x rays would constitute the beginning of the treatment The case should be closely watched and measurements *taken of the* lesion Good Kodachrome photography fol lowing each treatment is helpful in obtain ing dependable evidence of clinical progress

or metamorphosis of the lesion If the hemangioma is obviously regressing the treatment should be continued to its therapeutic maximum This implies caution and knowledge of possible complications which may result from any form of treatment Such knowledge determines the time and point of cessation of the therapy If with the passing of time and the growth of the child the lesion remains stationary provided that maximum application of the therapy has not been employed this may be augmented for a reasonable length of time If the lesion still does not regress or if evidences of complication as a result of the therapy appear or if the lesion is definitely degenerating or showing signs of malignancy then more radical therapeusis is indicated This may consist of electrodesiccation electrocoagulation electrosurgery or complete radical excision with reconstruction of the part

If on the other hand the less radical forms of treatment are able to control the lesion and keep it from spreading until the infant reaches an age when his co operation is available what remains of the controlled lesion may then be subjected to more radical forms of therapy

When the child reaches adolescence and the lesion is still stationary cosmetic coverage may be allowed so long as the hemangioma *does not show clinical signs of activity* As a rule cosmetic coverage is practiced by patients for only short periods of time after which they usually seek therapy that will rid them of the affliction entirely

If the original lesion observed in infancy is a combination of the superficial type of hemangioma (capillary or port wine stain) and the cavernous type the treatment employed in childhood may have controlled the superficial evidences of the hemangioma and done little or nothing for its deeper manifestations This change in over all appearance may be not only superficial but spotty or blotchy On the other hand the early treatment may have ablated all external evidences of the lesion Where the external improvement has been satisfactory, it may be possible to conserve the overlying skin and eradicate surgically or electrosurgically the underlying remains of the hemangioma

External appearance of course is the crux of the whole problem so far as the patient is concerned Consequently where any treatment substitutes a scar or a deathly white skin for the original hemangioma nothing much has been accomplished so far as the patient is concerned From the standpoint of the surgeon a minimal amount of scarring of the skin is not objectionable It can be disposed of through partial repeated excision with much more certainty and ease than the hemangioma But where scarring as a result of x ray or radium treatment is prone to be extensive and particularly where it may involve function of the part radical surgical ablation is advisable Where on the other hand surgery is liable to result in extensive scarring and functional involvement it too may be contraindicated except in cases where there is definite evidence of malignant degeneration or repeated ulcerations with infection

Therapeutic Procedures

Ultraviolet Irradiation This is recommended only for the port wine type of hemangioma A blistering dose is applied once a week for a period of three to nine months The blistered skin is then protected in the intervals by a light gauze dressing to keep the child from traumatizing it If the port wine mark is near the eyeball the latter must be protected from the ultraviolet rays MacCollum of Boston in reporting on results with this treatment states that definite cure in these cases is not to be anticipated *

Sclerosing Solutions Among the solutions commonly employed for the ablation of hemangiomas are boiling water hot hypertonic saline sodium morrhuate and

* MacCollum D W Personal communication

hypertonic glucose solutions A fine needle is inserted into the dilated capillaries or the cavern of the hemangioma and injected directly into the lumen To avoid embolism and undue diffusion of the sclerosing solutions any detectable communicating vessels of any size may be ligated prior to the injection or peripheral pressure may be applied about the lesion The complete ablation of a hemangioma by sclerosing solutions is never a certainty but it does stimulate fibroblastic proliferation and confinement of the lesion or partial ablation until such a time as excision is indicated or possible Much care must be used during injection treatment to avoid open ulceration

X rays and Radium X rays are not recommended except in very superficial lesions They frequently result in late scarring or x ray dermatitis which is a poor substitute for the hemangioma The port wine type of hemangioma has a very minimal sensitivity to radiation hence if pushed beyond intelligent limits always results in destruction of the skin with all the consequences of x ray dermatitis

Radium may be used as a bomb or in the form of radon seeds The radium bomb *is essentially a surface type of radiation* advantageous in the superficial types of hemangioma In the deeper types of the lesion where recurrences most often occur around the supplying arteries the surface radiation does little if any good Increasing it to a point where it does affect these deeper extensions only results in damage to the overlying skin ulceration and extensive scarring

The interstitial type of radiation is accomplished by means of implantation of gold radon seeds These are particularly useful where the hemangioma involves such structures as the nose the eyelids and the lips In children where excision would lead to difficult reparative plastic procedures radon seeds are most useful Another type of case suitable for radon is where the extent of involvement of the face is so large that surgery or for that matter, any other form of therapy is impotent or impractical

The insinuation of radon seeds into the tissues may be done under local or general anesthesia The gold seeds containing a known quantity of radon are then uniformly distributed by a special needle fitted with a plunger which forces the seeds into the tissues The seeds never should be deposited immediately under the skin or mucous membrane because of the unavoidable ulceration over the deposit This makes it somewhat difficult to use radon seeds about the eyeball or infant s epiphysis which is one of the drawbacks of this form of therapy

The radon content of each capsule may range anywhere from 0 25 to 0 35 millicuries The seeds are then distributed so that according to Byars approximately one radon seed per cubic centimeter of tissue to be radiated is employed After exhaustion of the radon content of the gold seeds the latter though retained need not be removed unless there is some definite indication for it such as obviousness under the skin or irritation of some delicate structure

Electrodesiccation consists of the application of small high frequency sparks to the lesion without producing contact between the electric needle and the skin It is done under local analgesia This is applicable only to very superficial lesions and always leaves a scar Therefore it should be used in small hemangiomas of a superficial type which are found on unexposed parts of the body

Electrosurgery Electrosurgical excision consists of the application of a bipolar high frequency cutting current with avoidance of actual burning of the tissue by flame The wound may be closed by direct suture approximation with fair hope of primary healing This is primarily indicated in lesions which show definite signs of malignant alteration and in regions where closure can be accomplished after excision

PLATE 15

Surgery of facial cavernous hemangioma (*Top left*) Preoperative condition frontal view (*Top right*) Preoperative condition profile view (*Bottom, left*) All of the hemangioma covering side of nose except rim of ala and the entire cheek was excised at one sitting The large flap from the neck was rotated upward to cover the cheek as far as possible The paranasal cheek area and the nose were covered by a full thickness free graft Lids were done with full thickness free grafts (*Bottom, right*) The lower eyelid shows minimal residual ectropion The fullness of the cheek is more apparent than real due to shadow Its degree varies with patient's weight and vigor The septum and the ala have been free grafted

Surgical Excision Where the hemangioma is not so extensive as to involve structures precluding surgery excision is the most expeditious way of eradicating the lesion If the lesion is comparatively small it will result in a minimal scar the healed suture line Where the lesion involves an area not amenable to immediate closure by direct approximation this may have to be *either free grafted or replaced by pedicled* tissue

Outright surgical removal is seldom indicated in infants and very young children In adults where other forms of treatment have failed or where there are definite signs of extension or malignant change in the lesion radical extirpation may be the only logical approach Since the hemangioma so frequently involves the exposed parts of the body in terms of form as well as appearance of the individual it remains an outstanding problem for the plastic surgeon (Plate 15)

It is absolutely necessary that the diagnosis of the extent and the depth of the lesion be made as nearly accurate as possible so that the advantage of immediate reconstruction of the surgical defect can proceed where possible There is no substitute for this type of surgery equal in the results thus obtainable Where immediate repair by collateral tissue is impossible it is necessary to have prepared beforehand an adequate pedicle of tissue which in size and integrity is equal to the surgical defect The planning of such pedicles and their methods of application is discussed in chapters dealing with specific appendages such as the lips nose eyelids ears and others

CONGENITAL HEMIATROPHY

Congenital hemiatrophy of the face is not a rare condition Its correction depends upon its surface extent and degree of involvement of the supporting structures There is almost always sufficient skin for the upholstering of the face The tissues wanting are subcutaneous fat and supporting skeletal structures The padding of the face with subcutaneous fat is a most difficult surgical problem The usual procedure is to mobilize a free graft of fat of predetermined size and thickness which is then inserted into the defect subcutaneously This is repeated with small portions of fat until the face is adequately padded The procedure almost invariably results in failure Lexer in the second decade of the century reported a case in which he transported a large mass of free fat to the cheek with success Lexer does not say how he mobilized his large free graft The writer has had a similar successful case with a large free fat graft mobilized according to the technic described in Chapter 16 But the mobilization of that type of free fat graft is such a tedious procedure that a much more simple and dependable method has since been evolved

The method is applicable not only to congenital hemiatrophy of a part but to any case in need of large amounts of fatty tissue (Fig 242) It consists of the making of a tubed pedicle in a region rich in fat The abdomen in men or the underside of a breast in older women are good donor sites The tube is then transported to the neck region immediately back of the angle of the mandible The other end of the pedicle is then implanted usually in the paranasal region of the affected side When complete healing has taken place and circulatory integrity of the tube is assured the latter is denuded of its epithelium with some of the underlying derma from one end of the tube to the other The tube is then transected at a predetermined point which is usually near its center A buttonhole incision is made near the underside of each peduncle through the skin of the cheek The skin is then completely undermined from below the lower border of the mandible up to the lower lid The two segments of the transected tube are opened into the form of two single pedicle flaps by excising the original

suture line Sutures are inserted into pre determined points of the two flaps which are guided subcutaneously on long straight needles into the cheek and withdrawn at the periphery of the cheek depression The opened segments of the tubed pedicle are pulled into their respective buttonhole in cisions spread and drawn into position by means of the guide sutures These are then tied over small rubber dams so as to avoid injury to the underlying skin and a pres sure dressing is applied over the cheek

Where the two segments of the transected tube must meet in the hollow of the cheek a separate buttonhole incision or two may be made into the center of the cheek so as to reapproximate the segments and thus establish direct continuity of the two

As indicated heretofore this tubal type of transportation of subcutaneous fat is ob viously much easier less time consuming and dependable than the free transplanta tion of fat The thin layer of derma allowed to remain on the tubal fat is important in stabilizing the fat pad and thus the forma tive quality of the cheek

The two peduncles still remaining exter nally and projecting out of the buttonholes mentioned above may eventually be excised or buried with final decortication of the epi dermis to augment the jaw angle and melo nasal area

The ultimate practical advantage in this method of tubal transportation of fat re sides in the fact that the amount of fatty tissue needed can be prepared and brought in at one time It is a one stage implanta tion which need not be repeated again be cause of fatty liquefaction absorption or substitution by fibrous tissue which always occur with the free transplantation of fat

CARCINOMATOSIS

Disseminated carcinomatosis of the skin of the face is a condition rather frequently encountered by the dermatologist It is usu ally referred to the roentgenologist but fre quently terminates in the hands of the plastic surgeon This depends upon its severity its lack of control by x rays and radium or because of the radiodermatitis consequent upon inexpert or overcourageous x ray treatment

It is a malignant condition of the skin most often involving the middle third of the face It begins either in the preauricular region extending then over the zygoma or in the region of the nasolabial crease and extends upward It eventually spreads downward over the mandible and upward over the forehead resulting in extensive ulceration of the entire skin of the face It was a condition not infrequently detected in the military personnel of World War II who for long periods of time were stationed in regions of high ultraviolet solar radiation such as the South Pacific and Texas

The therapeutic management of this con dition is not dissimilar from the story usually connected with the treatment of hemangiomas of the face All manner of applications from carbon dioxide snow par tial excisions application of ointments x ray or radium are tried to no avail The lesions go on to ulceration crusting exten sion dissemination and finally almost total involvement of the skin of the face Where the condition becomes extensive its surgi cal treatment falls in the category of con ditions discussed in Chapter 22 Full Face Graft

Where the condition is seen before com plete involvement of the face the patient should be advised to abstain as much as possible from exposure to sunlight Com plete wide excision of the involved skin should be done with either full thickness free grafting or pedicle flap repair of the surgical defect Where the involvement is still restricted to the preauricular area all of the skin from the level of the eyebrow external to the outer canthus of the eye down to the angle of the jaw should be ex cised with the superficial layer of the sub cutaneous tissue and grafted If the lesions first appear on the forehead all of the skin

of the forehead should be excised at one sitting Nothing is to be gained ultimately by a simple biopsy excision such as is practiced with isolated lesions of the lower lip for instance

LUPUS VULGARIS

The surgical treatment of lupus vulgaris is an expeditious adequate and successful form of therapeusis Where a lupus lesion exists—and it usually involves the naso labial triangle—an adequate amount of tissue in the form of a pedicle should be prepared before excision of the lesion When the lesion is being excised not only the skin but its subcutaneous tissue should be taken with it including a zone of normal skin for a distance of about a quarter of an inch to all sides of the pathology The pedicled tissue prepared beforehand is then sutured into position When complete organization has taken place a secondary esthetic revision of the part is done The affliction should not be allowed to go to the point of deep ulceration and involvement of underlying supporting structures but should be remedied before this occurs Otherwise prolonged and complicated reconstructions will be necessary which are never entirely satisfactory

From time to time chemotherapeutic methods for Lupus Vulgaris (common in central Europe and the Orient) make their appearance (calciferol) Even if in the end these should prove eminently successful in eradicating the disease they will have little influence upon the ablation of the defacements remaining due to pigmentation ulceration and scarring This will still remain a problem for reconstructive surgery

General Derangements affecting the entire face are made up of conditions such as a panfacial burn (see Chap 22 Full Face Graft) accidental dissem nated tattoos complete bilateral facial paralysis or any of the conditions discussed under Segmental derangements if and when they involve the entire face

POCK MARKS

The plastic surgeon is frequently consulted by patients suffering with the scarred residues of former skin affections of the face commonly referred to as pock marks These are of two types the localized and disseminated Either of these types may be superficial or deep Whether deep or superficial little can be done in the way of esthetic improvement in the disseminated type Repeated excision of an individual pock is an impractical procedure because in the disseminated type there is not enough normal skin left between individual defects to do a reliable closure Even if this were not so the time element involved in the removal of hundreds or even thousands of such marks would make the procedure unwise

Application of escharotics with a view of decorticating the scarred epidermis is not good treatment If done cautiously it is usually inadequate If done courageously it is dangerous because the resultant vesiculation may lead to permanent complete scarring of the face Repeated decortication by a specially constructed small dermatome has not proved to be a successful method because the unavoidable fibrosis of the derma contingent upon repeated surgical trauma leads to a strange appearance of skin which is not much better than the original condition

Small pocked islands of skin or individual pocks few in number may be excised with benefit to the patient s appearance The excision must include the entire thickness of the skin One must make certain that the incisions into the skin are definitely made into healthy tissue or the resultant suture scar will be a poor substitute for the excised defective skin

FACIAL CLEFTS

Embryology Clefts of the face are not uncommon They are tissue derangements rather than actual voids leading to malformations of the features the result of

tissue displacement or misdirection They are embryologically reconcilable with the development of the forebrain and of the various processes whose incomplete fusion results in so called facial clefts In extreme cases there is early and almost complete arrest of development of all parts which normally form the face This type of condition is known as aprosopus Cleft in the upper lip, the palate and the maxilla follow the lines of primary union of the various frontonasal, global and maxillary processes which enter into the structures their fellows of the opposite side, thus resulting in closure of the mouth slit and resulting in atresia of the mouth or astomus Clefts in the lower lip are exceedingly rare and are the result of imperfect fusion of the two mandibular processes (Fig 333)

In discussing with parents, the causation of facial clefts, one should impress upon their minds the fact that normally fusions of the various regions of the face are completed by the eleventh or the twelfth week of embryonal life This avoids suspicions between members of the family, dissipates

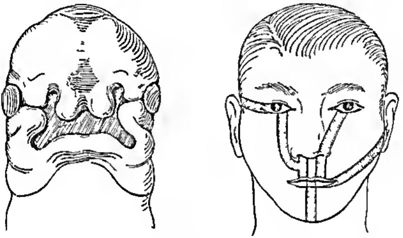


Fig 333 The similarity of relationship between the normal clefts in the embryo and the usual sites for abnormal clefts of the face in the adult

Occasionally, there is lack of union between the frontonasal process and the process of the maxilla This results in an oblique cleft extending upward from the mouth and referred to as the oblique facial cleft technically known as cheilognathoprosoposchisis The processes which go into the formation of the boundaries of the mouth that is the maxillary and the mandibular, occasionally fail to unite and so give rise to the condition known as macrostomus (large mouth) On the other hand, the fusion may proceed beyond normal limits thus giving rise to microstomus Finally, there may be complete fusion of the processes on one side with each other and with superstitions about these conditions, and disciplines others during the operation

Any of the facial clefts may be superficial deep or complete The latter usually involve one or more of the cavities of the face

From a reconstructive standpoint ordinarily one finds an adequate amount of tissue present about the clefts for complete repair Basically, the tissues in these conditions seem to be displaced and somewhat deranged rather than wanting For this reason clefts are placed under the heading of derangements rather than under the classification of voids The important thing in the reconstruction of these defects is that

an accurate anatomic layer to layer repair be done What applies to the repair of the cleft lip and the cleft palate as to time for reconstruction applies as well if not more so in the case of other facial clefts In other words they should be repaired as early in life as possible consistent with the condition of the patient so that the development of facial symmetry will not be interfered with Where supporting structures are wanting or inadequate they must be supplied during later operations In this connection one never must be tempted to force bony structures together In so doing one forces them out of alignment with adjacent bony parts and creates an irremediable deformity out of a remediable defect That is one of the basic errors underlying the Brophy uranoplasty (see Chap 34 Lips and Oral Cavity)

EXCESSES

True tissue excesses of the entire face are rather uncommon They consist of such conditions as leontiasis ossea soft tissue hypertrophies skin ptoses acromegaly etc The false tissue excesses—or apparent excesses—are many and varied ranging from the various forms of edema to the countless numbers of tumors which may affect the tissues of the face Among the latter are tumors of the salivary glands

The true tissue excesses affecting the face are almost invariably of congenital or metabolic origin The false tissue excesses on the other hand are usually of neoplastic or acquired origin

True

Leontiasis ossea is a bilateral symmetric hypertrophy of the bones of the face and the cranium resulting in a lionlike facial appearance Its exact genesis or pathology is not completely understood The bone changes so characteristic of the disease seem to be exclusively confined to the head and the neck

In this condition the plastic surgeon can do little from the standpoint of general reconstruction It is only in its complicating features that local bony excisions may be necessary with soft tissue revisions dictated by alteration of bony support Such local revisions are indicated only where the bony hyperplasia infringes upon the integrity of the basic functions of mastication swallowing or respiration

One of the more usual complications associated with leontiasis ossea is the inability of the patient to open his mouth adequately without occasioning pain in the sternocleidomastoid region or the hyoid This is essentially due to a hyperplasia of the mandible particularly of its angles with masseter hypertrophy so that as the patient opens his mouth the angles produce pressure on the soft tissues in the neck region and impede the progress of the lower jaw

This condition can be remedied readily by partial resection of the angles of the jaw A curved incision about two inches in length is made under the angle of each lower jaw to the depths of its periosteum which is then stripped from the mandible to a predetermined distance Three small drill holes are made one superiorly one through the angle and one somewhat inferior and anterior to it A Gigli saw is then inserted into the upper drill hole The saw is directed toward the central drill hole and finally toward the anterior one so that a section of the angle is removed in the shape of a quarter moon The periosteum is then closed over the bone The soft tissue overlying it as well as the skin are closed in layers There is seldom much oozing from the bone in leontiasis ossea so that pressure dressings are not necessarily indicated except that they may help prevent postoperative edema in the soft tissue about the jaw Resection of the masseter may be necessary

The patient experiences immediate relief from pain postoperatively when opening his mouth Recurrence of bone hyperplasia or hypertrophy of the masseter following excision is not to be anticipated (Fig 334)

FIG 334 (*Top*) Shows preoperative condition of mandible in leontiasis ossea and postoperative condition after circumsection of angles with sagittal resection of the masseters The jaws were so hypertrophied that the patient had difficulty in opening his mouth and swallowing and had persistent pains in suboccipital region (*Bottom left*) Preoperative roentgenogram (*Bottom right*) Amount of bone excised from mandibles

Dermoptosis

Facial dermoptosis is the condition commonly referred to as sagging face It is marked by an excess of skin about the lower jaw and neck It is associated with pronounced wrinkling and frequently with sagging of the skin of the eyelids and creasing of the forehead It may or may not be *associated with a generalized tendency* toward dermoptosis In women it is frequently associated with pendulous breasts It is often a familial trait

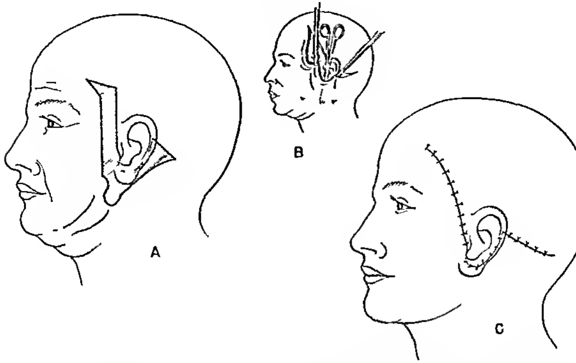


Fig 335 Facial rhytidectomy (Joseph) (A) Planned skin excision (B) Type and extent of undermining of skin and subcutaneous tissue (see text) (C) Closure (Operation as outlined, only applicable to moderate ptoses) (See also Figs 336 and 337)

There are two types of dermoptosis the congenital type and the acquired or senile type The congenital type is a hereditary peculiarity, usually involving the skin of not only the head and the neck but the torso and, to some extent the extremities Several members of one family may be afflicted This type makes itself manifest quite early in life, more prominently in the female, at first by looseness of the skin about the neck later on the upper chest and the axillae Frequently, the breasts in such young women will take on a soft feel, and a definite ptosis of the appendages will be noted The skin anywhere on the body is thick, feels dry stretches easily to beyond expected limits and returns to normal tension slowly The subcutaneous tissue is fairly well developed in contrast with the senile type, although its consistency like that of the skin, is on the soft elastic side Displacement or stretching of the skin has little influence on the extent of wrinkling

The senile type of dermoptosis is that usually seen in older women and, in contrast with the congenital type is thin and marked by relatively profuse wrinkling It may be dry even scaly and is inelastic It is a thin skin with a meager subcutaneous fatty layer under it Displacement or stretching of the skin reduces markedly the amount of wrinkling

Microscopically the latter differs from the former in that the glandular elements are atrophic in appearance the venous supply of the skin predominates, the epidermis is relatively thick and the intrinsic fatty layer in the deep portion of the derma has been replaced by fibrous tissue

Methods of Reconstruction The operative procedures recommended for the remedyog of dermoptosis are many and varied Technically such an operation is known as rhytidectomy (facial rhytidectomy or cervical rhytidectomy)

Hollander is credited with the first report

of an operation for this condition in 1912 although others before him including Lexer are known to have performed operations for facial dermoptosis The procedure most commonly used contemporarily is that of Joseph or some modification thereof (Fig 335) Joseph s operation reported in 1920 was shortly thereafter followed by one by Noel of Paris The latter is much simpler and also much less useful than that of Joseph Following Noel s description of her method the operation of facial rhytidectomy gained the unwarranted reputation of being a very simple and homely procedure consisting essentially of the excision of relatively small segments of skin in the region of the parietal hairline or the back of the neck

The fact is that any procedure adequate to deal with facial or cervical dermoptosis is a comparatively radical one This depends to some degree on the extent of ptosis of the facial skin Notwithstanding adequate surgery in this condition involves large appropriate and comparatively inconspicuously placed incisions radical undermining of all of the skin of the forehead cheeks lower jaws and the anterior triangles of the neck including the submental region Usually the operation can be done under local analgesia with adequate premedication

Practically all contemporary approaches in these operations are based upon an incision which begins in the region of the temporal hairline moves down anterior to the auricle around the lobule returning superiorly behind the auricle to the mastoid hairline and then posteriorly as far as seems to be necessary considering the extent of the wrinkling of the skin of the neck It may have to be projected to the occiput

The incision must be a clean decisive sweep around the ear with a very sharp scalpel It should not go beyond the superficial layer of the deep fascial plane in the

FIG 336 Cervicofacial rhytidectomy (*Top*) Circumauricular incision and extent of undercutting of the facial and cervical skin Note upper extremity of pre auricular segment of incision projected into hair line of temporal region This is necessary in cases of extreme looseness and sagging of facial skin (*Center*) Cephalad displacement of mobilized loose skin of face and neck This indicates amount to be excised about the auricle and the temporal region (*Bottom*) Skin excision completed wound ready for closure Note acute inferior angle of wound This allows for retention of triangular bit of skin under ear lobule and avoidance of postoperative undercutting by scar contracture with displacement of the lobule

FIG 337 The operation of rhytidectomy (*Left*) Preoperative (*Right*) Two years postoperative

region of the jaw This is necessary in order to avoid injury to the deep blood vessels in that region the facial nerve or the parotid gland On the other hand the incision and the undermining must not be so superficial as to be external to the subcutaneous fat or the extensive freeing of the skin will result in patchy gangrene

With the completion of the undermining the freed skin is pulled up over the ear and the mastoid region with forceps and is held there by the assistant The amount and the pattern of excision of superfluous tissue is then outlined by scalpel scratches and is amputated Some authors prefer to calculate the amount of excision preoperatively Although this is possible it is not entirely safe or reliable especially in the hands of the novice The closure of the incision must be as meticulous as is physically possible because the operation is obviously done only for esthetic reasons and a poor periauricular scar is a regrettable and unnecessary substitute for the remedying of a wrinkled skin

When the operation is completed adequate pressure dressings must be applied to the entire undermined region The mobilized skin must be accorded the same postoperative consideration as one would give an extensive flap Finally with the removal of the sutures which should be undertaken on the fourth or at the latest the fifth day the young suture line must be protected by supporting the newly elevated skin against the pull of gravity and the exigencies of chewing yawning or any other form of like trauma for a period of at least 12 days This may be accomplished quite inconspicuously by having the patient wear a 1 inch gauze strip glued over the suture lines with collodion during the day and some type of elastic support to the face during the night

If the operation has been done properly and if the postoperative management has been adequate the results can be main

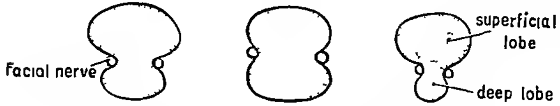


FIG 338 Position of facial nerve within substance of parotid gland (Hamilton Bailey)

tained other things being equal for a period up to six or even eight years It is impossible of course in this type of operation to expect so called permanent results because no surgical procedure is able to stop the ravages of aging the uncompromising effect of gravity upon all tissues and the unavoidable further sagging of the skin of the face and the neck as the years go by

If on the other hand the operative procedure employed was a simple excision of small segments of skin (Noel method) either the immediate postoperative results will be inconsequential or within a period of a few weeks the advantages gained through forceful stretching of the skin rather than a displacement will have been lost and the original condition will have returned

FALSE

Tumors of the Salivary Glands These are mentioned here only for the sake of differential diagnosis of tissue excesses

The neoplastic afflictions of the salivary glands can result in a facial appearance which may be classified under tissue excesses In accordance with the classification employed these would fall under the false type of excesses Foremost of the salivary glands is the parotid (see Fig 5A *top*)

The surgical pathology of tumors of the parotid gland is not only fairly complex but deserves more comprehensive treatment than can be accorded to it in a text of this limited size Therefore the student is referred to more extensive works on general pathology

Obviously the simple benign tumors of the parotid can be removed by appropriate incision and enucleation It is the more extensive and often malignant tumors of the gland that deserve mention here Such neoplastic conditions frequently mean complete parotidectomy For some mysterious reason this type of operation is still looked upon by surgeons in general and by the general practitioner in particular as a surgical act unavoidably terminating in facial paralysis if not complete deformity of the face

According to Hamilton Bailey this apparition of facial destruction is the result of the fact that the classic descriptions of the anatomy of the parotid are inaccurate in their description of the facial nerve * He emphasizes the fact that the facial nerve does not plunge into the main body of the gland and there divide within the parenchyma but rather pursues a relatively approachable course through a bilobed organ the parotid He likens the course of the facial nerve through the parotid gland to the meat within a parotid sandwich (Fig 338)

The factors which make surgery of the parotid more difficult than the much feared anatomy are essentially technical They are inadequate incision uncontrolled oozing hurry impatience dramatic performance and dull dissection There is no better way to obliterate anatomic details and to lose one s self in a maze of tissue fragments than dull dissection in this region He who cannot deal with the parotid by means of the scalpel and cleavage dissection would do well to stay away from the gland Notwith

* Bailey H Parotidectomy Indications and results Brit M J 1 404 1947

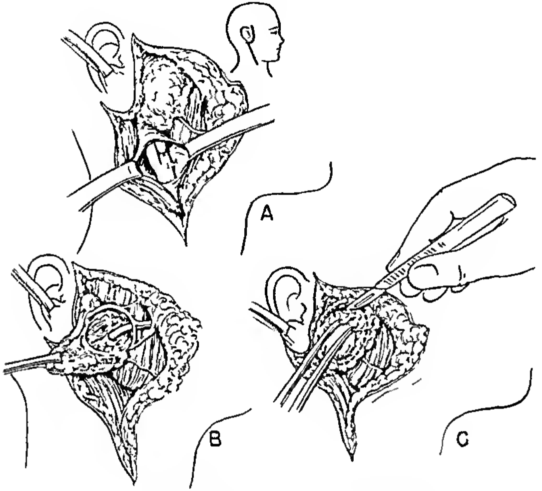


FIG 339 Surgical approach to and excision of tumor of the parotid gland (modified after Hamilton Bailey)

standing, the difficulties set forth in operations on the parotid—the really difficult problems—are those of reconstructive surgery that is necessary as a result of bungling surgery of the gland

For procedural approach to the parotid, see Figure 339

The two conditions affecting the submaxillary glands, the one quite common and the other much more serious, namely, a stone in Wharton's duct or carcinoma of the gland, may be classified under false tissue excesses of the face Removal of the gland in either case may be necessary In the latter, it must be done without compromise In the former, the approach may be through the mouth, in the latter, it is transcervical Both these conditions must be differentiated from the more simple enlargements of the gland, one of which is obstruction of Wharton's duct Obviously, from an esthetic standpoint the transmucous approach through the mouth is the more appealing one Nevertheless, in malignant afflictions of any of the salivary glands, esthetic considerations never must take precedence over complete eradication of the disease

Although the first consideration in dealing with tissue excesses of the neoplastic type is the eradication of the disease, incisional approaches, gentle handling of tissues, meticulous cleavage dissection, accurate repositioning of tissues in closure,

and fine approximation of the skin edges should be made for the sake of the patient and must be made for the sake of surgery As noted in an earlier chapter, the quality of a skin closure is very frequently an index to the quality of the surgery underlying the incision

CARCINOMA

Carcinoma of the face as it is usually encountered, signifies malignant involvement of one of the facial appendages such as the nose lip ear or eyelid Its discussion is therefore, reserved for chapters dealing with such anatomic entities Recognized surgical therapeusis that is radical extirpation of the involved part commands its discussion under total voids of that part

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31

Genitals (Genitoplasty)

GENERAL

The subject matter of this chapter is restricted to consideration of the male and female genital organs Plastic surgery of the genito urinary system is too extensive for adequate treatment in a volume designed to outline the application of principles to problems of student concern and general applicability Discussion of the numberless procedures applied to the urinary system proper where standardization has not yet reached the level of acceptance or application more common to other fields, would at this time serve no useful pedagogical purpose Only insofar as the principles of plastic surgery and the procedures derivable therefrom can be applied to clinically common, but frequently undelineated situations has a deviation from this plan been risked

The genito urinary surgeon, in the same way as the ophthalmic surgeon the rhinologist and others, feels it within his province to indulge his surgical privileges in the reconstruction of parts anatomically related to his specialty The fact is that the basic ideas of reconstruction can no more be walled off by anatomic subdivisions of the human form than can the physiology of the stomach be the exclusive intellectual property of the abdominal surgeon The principles and premises of plastic surgery deal not so much with the exclusion of pathology from the healthy remains but more so with the re inclusion of a functionally reconstituted part in the economy of the individual It is not a question as to who should get the penis but rather a question as to what form of surgical therapeusis can restore the organ to the patient in the best possible functional state Insofar as it is the plastic surgeon's primary purpose to reconstruct tissue defects, wherever they may be, and until such time as the principles and motives of reconstructive surgery become part and parcel of other specialties, it remains the plastic surgeon s duty to expedite the progress of functional surgery, irrespective of the anatomic location of a defect

As indicated heretofore, this chapter is mainly concerned with certain problems incident to the genito urinary system, not routinely covered in standard texts on genito urinary surgery

PENIS (PHALLOPLASTY)

Voids

Total voids of the penis are very rare They are more common in warfare than in civilian life In the latter they are usually due to self mutilation or more commonly to amputation by the surgeon for exclusion of a malignancy, and occasionally the result of a vehement human bite

Adequate functional or formative reconstruction of the penis is not as yet possible When attempted, it is done for one essential purpose—to provide a penile urinary tract This is not altogether satisfactory because of the improbability of adequate urinary control When the attempt is made at a total phalloplasty, the mimicry of the organ may be accomplished by the inclusion of a small inverted tube rawside out, within another larger tubed pedicle The former may be made from the skin and the subcutaneous tissue of the medial thigh, where is

the latter may be constructed from the superficial tissues of the abdomen (For mimicry of glans cf Fig 347) They may both be made on the thigh

The construction of a penile urethra by means of the insertion of a split graft wrapped over a catheter raw side out throughout the length of the tubed pedicle constituting the main body of the organ is not to be recommended too highly The percentage of final failures is still too high

Partial voids of the penis may be divided into four types those of the skin covering of the organ corpora cavernosa the urethra and the glans penis

CUTANEOUS AVULSIONS Avulsion of the skin of the penis is an unusual accident When it does occur it is the result of implication of the skin of the organ in the twisted trouser caught by rapidly revolving machinery

The condition may be managed in two ways either by incising the scrotal skin in the midline below the penis and embedding the denuded organ in the scrotal bed or by free grafting the raw penis with a thick split graft Where the scrotal skin is involved in the injury—as it often is—only the second method is available Neal Owens L T Byars J B Brown Frovlovs Burian and others have individually reported usually on one and at most three cases of restoration of the avulsed covering of the penis Owens who has reported two cases states that the end result from a scrotal skin flap is not as satisfactory as from the

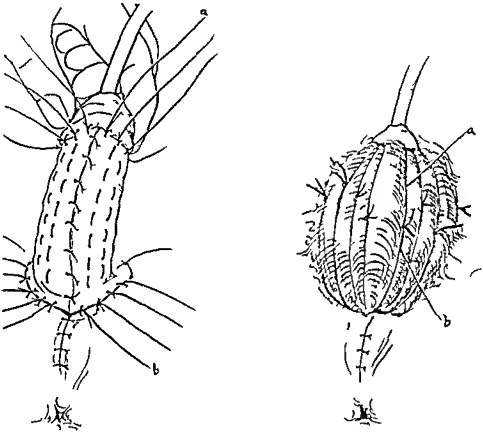

FIG 340 Method of free grafting dressing and splinting of avulsed penis (Byars)

Fig 341 *Results of total free grafting of* avulsed penis, 3 months postoperative

half thickness skin graft because of the increased thickness and the loss of pliability resulting from the former method "*

Byars summarizes the equitable management of acute traumatic avulsions of the penile skin as follows

These cases are presented first with the idea of expressing the desirability of primary repair rather than subjecting the patient to the prolonged discomfort coincidental with secondary repair In addition, it is felt that skin grafting of properly prepared open wounds resulting from avulsed tissue is practical and should be considered even though a number of hours have elapsed since the injury † [Fig 340]

As indicated heretofore, total avulsions of the penile skin are so frequently attended by partial or total avulsion of the skin of the scrotum that immediate attention to the latter is necessary and unavoidable In this connection Byars concludes

In none of the three cases was restoration of the scrotum attempted It is obvious that under some circumstances such a reconstruction might be considered essential If this is *contemplated, the testicles* should be planted under the skin and subcutaneous tissue of the upper, inner thighs at the time of the initial repair After the defect of the penis has been adequately repaired and healed, each testicle and its cord would be dissected free from the thigh, carrying with it the overlying skin and fat The tissue from the right and left thighs would then be sutured together in the midline, the testicles with their overlying skin and fat being joined to make the two halves of the reconstructed scrotum This would occupy approximately the normal position and probably maintain nearly the optimal temperature *of these organs This reconstructed scrotum* would not be contractile The two donor sites on the inner surface of the thigh would be covered with split thickness skin grafts §

*This adequately summarizes the princi*ples underlying this unusual problem and with certain few differentials which may perforce be dictated in the technic or procedure *by virtue of complicating circum*stances, presents the student with adequate basic substance for the comprehension of this problem (Fig 341)

Corpora Cavernosa Partial voids of the corpora cavernosa are the result of gunshot wounds, stab wounds, human or animal bites or neoplasias If only one cavernous body is affected, erection of the penis may still be adequate though at times somewhat uncomfortable because the organ has a tendency to bend to one side

Reconstruction or reconstitution of voids of the corpora cavernosa are an unsolved problem During World War II, where gunshot wounds of the penis were not altogether rare and since the afflicted for the most part were very young men attempts of various sorts were made to reconstitute the injured organ For the most part these consisted of the insertion of autogenous cartilage, and in some cases homogenous substance, in an attempt to give solidity and mimicry of erection to the organ (Fig 342)

The results as far as can be ascertained were uniformly unsuccessful The author

* Owens, N Reconstruction for traumatic denudation of the penis and scrotum Surgery 12 88 96 1942

† Byars L T Avulsion of scrotum and skin of penis Surg Gynec & Obst 77 326 1943

§ *Ibid*

FIG 342 (*Left and Center*) Gross injury of corpora cavernosa with fiddlestring contracture of penis, the result of a gunshot wound The redundancy of skin below glans due to organized hematoma Approximately half of the left and two-thirds of the right corpus were missing Note cystotomy wound over pubic region (*Right*) Reconstruction of penis after insertion of costal cartilage bar between remains of corpora cavernosa Necessary skin coverage for penis after excision of fiddlestring scar was salvaged from redundant skin below glans (Appearance 2 months after 4 acts of copulation)

has had occasion in four separate instances to attempt cartilaginous reconstruction of such a mutilated penis. In all of these cases autogenous cartilage was employed It was removed from the patient's own rib cartilage

The scar tissue consequent upon injury to the corpora cavernosa was excised, and the intercavernous space was laid open The dorsal skin of the penis is then undermined This undermining is carefully carried to the suspensory ligament of the penis. A cartilaginous bar is then shaped in the form of a rod approximately 3/8 inch of diameter and four inches in length Several drill holes were made through it, 3/16 inch in diameter and spaced at intervals of 3/8 inch The perforations alternate so that every other one runs at right angles to the one preceding it This is done for two reasons: to enhance the nutrition of the cartilage in its center and to avoid curling of the graft The cartilaginous bar is then sutured to the region of the suspensory ligament with fine chromic catgut The remains of the dartos and the fascial investments of the corpora are then sutured about the graft and the skin closed loosely over it.

Since the graft itself acts as a splint to the penis, that problem in this case is not as difficult as it is in other reconstructive procedures upon the organ The insertion of a catheter is not necessary in these cases but the coverage of the dressing with a rubber condom is advisable to prevent wetting in the course of urination A minimal opening is made in the condom over the mouth of the urethra, and the edges of the opening are secured to the glans by means of four fine sutures and collodion

As indicated heretofore, the results in connection with this operation have been uniformly unsatisfactory in many ways The cartilage may absorb, curl or warp, or it may be extruded in the course of any residual erection Above all, most patients following use of the reconstructed organ in copulation complain of pain in the region

of the pubis due to impact of the cartilage graft against the pubic bone during inter course

URETHRA Urethral voids per se may be traumatic or congenital Major traumatic voids of the urethra are so rare that few authors ever have seen one When encoun tered they are usually only partial losses due to knife wounds war injuries or crotch injuries Congenital absence of the urethra or a major portion of it is usually associated with hypospadias or epispadias

TRAUMATIC It is rare for a traumatic in jury to tear out extensive segments of penile urethra without major involvement of the penis itself Where such extensive injury to the urethra does occur there is almost in variably major avulsion of the skin of the penis including the scrotum which ipso facto must precede direct injury to the spongiosum and the urethra itself Hence when the urethra is actually injured in such cases reconstruction presents problems en tirely different from that found in the congenital types of absence associated with hypospadias or epispadias

This of course does not hold true for traumatic loss of the urethral lining *only* which is usually due to accidental or at times intentional injection of some type of escharotic substance eventuating in deep stricture The most common sight of injury to the male urethra as a result of direct trauma is the bulbous or membranous por tion thereof This may or may not be asso ciated with fractures of the pelvis Some 25 years ago J H Garlock made a quite com prehensive study and report of this type of injury His report emphasizes the rarity of this condition

The treatment of that type of injury de pends entirely upon the time which has elapsed since the trauma When seen clearly immediate control of very extensive hemor rhage is the first thing The very next neces sity is diversion of the urinary stream Where loss of the penile urethra is confined to its anterior third diversion of the stream by catheter may be permissible although difficult In most cases the safest procedure is a suprapubic cystotomy or perineal urethrotomy as recommended by Riba

Where as indicated above there is con comitant extensive loss of the undersurface of the penile skin as well as the scrotum there is little opportunity for immediate re construction of the urethra Hence after diversion of the urinary stream whatever skin may have remained on the dorsum and the sides of the penis may be split dorsally so that the two flaps resulting pedicled both proximally and distally on the organ may be shifted to the underside of the penis and thus cover the raw area Prior to shifting the dorsal skin of the penis to the underside of the organ the proximal and distal seg ments of the urethra remaining should be identified closed with a purse string of fine silk and allocated in the traumatized soft tissues of the underside of the penis for future identification The wound should allowably be irrigated thoroughly with copious amounts of saline before coverage The surgical defect left on the dorsum of the penis after the dorsal slit is made must be free grafted as in avulsion of the penile skin

Where there is not enough of penile skin left on the dorsum or the sides of the organ for coverage a thick split graft may be the only method of treatment for the time being

When the acute consequences of the in jury have subsided the closure clean and the wound organized one of many types of reconstructive procedures (found under dis cussion of hypospadias) may be employed in the reconstruction of the missing portion of the urethra

HYPOSPADIAS The history of the surgery of hypospadias and epispadias are outstand ing examples of the need for more physio logic surgery in this connection Of the 23 separate procedures reported to date none is claimed to have given consistent results in any large series of cases This includes

procedures outlined by Bucknall, Binnie, Legueu C H Mayo Beck, Russell, Schmieden, Bevan, Ombredanne and many other older authors Modifications of these various operations (and particularly Russell s and Ombredanne s) only add to the great number of procedures extant The most recent modifications of older methods have been reported by A W Farmer Young and A E Goldstein

Preoperative Management Most of the patients presenting with hypospadias are children As a rule it is not necessary to operate on this condition prior to the age of five nor should it be delayed any longer than is consistent with the child s entry into school and avoidance of psychologic insults from his schoolmates

The general preoperative management in these cases is almost entirely dependent upon solution of the problem of urinary flow In most operations for hypospadias urinary diversion is necessary The Ombré danne operation can be done without diversion of the urinary stream Where this is unavoidable it may be done by preliminary perineal urethrotomy (Riba) or suprapubic cystotomy In children the latter is best performed by the stab insertion of a catheter such as that of de Pezzer This may be inserted through a stab wound into the bladder and needs few if any sutures for its maintenance if subsequent suction is constant and adequate

Surgery No matter what method of approach is selected by the surgeon ultimate success in the correction of hypospadias depends on thorough preliminary straightening of the penis In practically all cases of hypospadias the organ is afflicted with a ventral contracture This is due to absence of the urethra and the corpus spongiosum

The correction of the ventral contracture of the penis with complete straightening of the organ is the first of three procedures which comprise the plan of reconstruction This is accomplished by complete excision of the fibrous bands holding down the penis through a transverse incision which when adequately undermined and extended allows relatively free access to the contracture The remaining surgical defect can usually be closed longitudinally with whatever skin is available on the penis and the scrotum or if too extensive it may be free grafted

The second phase of the reconstruction of a hypospadiac penis is the construction or augmenting of the urethra This task is somewhat dependent upon the position of the hypospadiac urethral opening The latter may be found anywhere from the location of the frenum to a perineal location The first is usually referred to as the glandular type of hypospadias Strictly speaking this is a misnomer because there does not exist any involvement of a gland There seems little reason why it should not be referred to as the glansular type of hypospadias This could very properly be correlated with the connotation hypospadias of the glans The other types are the penile scrotal and perineal The frequency of occurrence is in about that order

It is in the construction of a urethra where the methods of approach differ From the standpoint of the plastic surgeon they may all be classified into three types those based upon the construction of the urethra from a free graft those dependent upon the construction of the urethra from the tissues available on the penis and the scrotum and those designed to create the urethra from tissues adjacent to the penoscrotal area such as the thigh Each one of these basic approaches has its merits but none can be applied routinely to the management of hypospadias The factors influencing judgment in this detail are in principle the same as those that apply to the reconstruction of any other anatomic part by the use of the different types of material In extensive cases all three types of approach may have to be used The ultimate aim of course from a practical and functional standpoint should be to construct the urethra if at all

possible from tissues available on the penis and the scrotum

The difficulty encountered in the use of the free graft is the tendency for prolonged contracture of the newly formed urethra necessitating protracted dilatation The primary difficulty encountered in the use of the scrotal skin more so than that of the body of the penis is the possibility in later life that hair may appear within the urethra The objections to the importation of tissue collateral to the penoscrotal region are the many stage procedures necessary and the dangers inherent in the transportation of any type of tissue to a recipient site particularly when that site is contaminated

Procedures The Bevan procedure is only applicable to the glansular type of hypospadias It is accomplished by making a channel through the glans into which is drawn a flap dissected from around the abnormal hypospadiac opening (Fig 343)

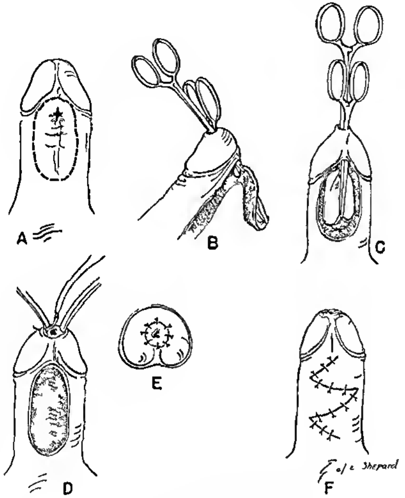

Fig 343 Reconstruction of glansular hypospadias (Bevan) with modification of skin closure

The Ombrédanne procedure is one primarily applicable to the penile and often to the penoscrotal type of hypospadias In this operation the inadequate urethra is augmented and projected to or even into the glans by the formation of a skin pouch from

the ventral penoscrotal surface It is made possible by the anterior rotation of a scrotal flap which is then sutured rawside out under the glans in such a way that an opening remains for urinary exit The raw surface remaining on the ventral side of the penis and over the scrotum may in certain cases be closed by undermining of the remaining skin of the penis and scrotum with direct approximation in the ventral midline Where this approximation is difficult or inadequate it may be supplemented by a transposed flap taking its origin in the substance of the prepuce (Fig 344)

This simple type of operation although applicable in many cases is inadequate in some and must therefore be augmented by further dissection and patterning of flaps from skin surrounding the root of the penis Another objection in detail to the Ombrédanne procedure is the fact that in its original form it terminates in a straight line closure on the ventral surface of the penis which leads to a fiddlestring contracture in certain cases

This frequently necessary modification of the Ombredanne procedure has led A W Farmer to a modification thereof which allows ample opportunity for the correction of almost any type of penoscrotal hypospadias (Fig 345)

Postoperative Care Whatever procedure is employed in the correction of this condition it frequently fails for two reasons the first is that the tissues are not properly designed to fit the case handled gently enough to withstand the ordeal of healing and often disposed in such a way as not to allow for the gross postoperative swelling or probable erection of the organ Secondly inadequate provision is made for postoperative surgical cleanliness resulting in destructive infection of the repair and unavoidable failure

With the advent of chemotherapy and a better understanding of the postoperative management of tissues greater successes are reported with many procedures which otherwise would terminate in a large number of failures

EPISPADIAS is a rather rare congenital deformity represented by absence of all or a portion of the roof of the urethra In contrast with hypospadias the penis is usually curved upward

Preoperative management in epispadias is not unlike that of hypospadias Some type of urinary diversion preferably perineal must be employed As a matter of fact practically all the older operations and most of the contemporary operations dealing with epispadias accomplish nothing more in the end than a diversion of the urinary stream The advantages existing in the correction of hypospadias are almost entirely absent in the problems arising in epispadias Fortunately the condition is much rarer than the latter It is often associated with diastasis of the pubic bones and not infrequently with exstrophy of the bladder When it is compounded with the latter it is a situation for which no adequate surgical answer exists as yet at least not of an integrity yielding consistently reliable results

Diversion of the urinary stream in the situations compounded by exstrophy of the bladder may be accomplished by transplanting the ureter per se or with bladder tissue into the intestine externally into the skin or posteriorly in the region of the loin In any case the postoperative condition of the patient is still not adequate to ordinary requirements of living When such operations are successful they somewhat ameliorate the pain and suffering associated even though actual anatomic cure has not been accomplished

For an epispadias without a complicating exstrophy of the bladder the tissues of the penis itself must be employed in the construction of the urethra with what little skin is available in the region of the pubes for supplementary coverage The objection to the latter is the eventual growth of hair in the transplanted pubic skin so that late

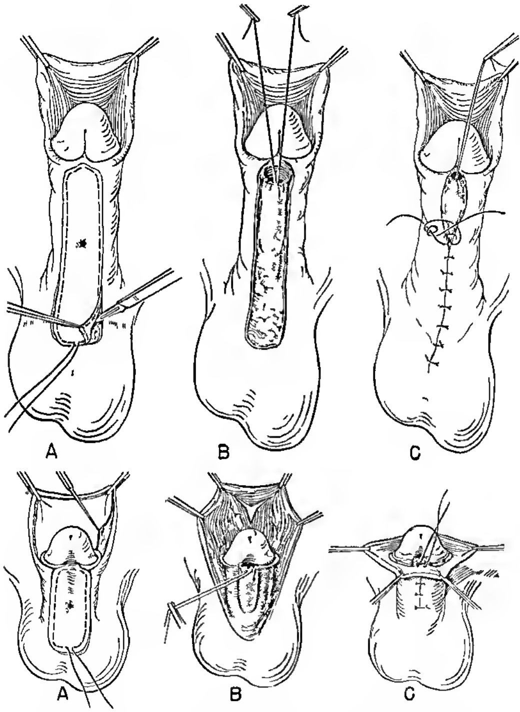

FIG 344 Two reconstructions of penile type of hypospadias (Ombredanne)

complications are almost unavoidable Upon the premise of constructing the urethra from the penile tissues is based the original classic operation of Thiersch as well as that of Cantwell which later were modified by H H Young to a degree

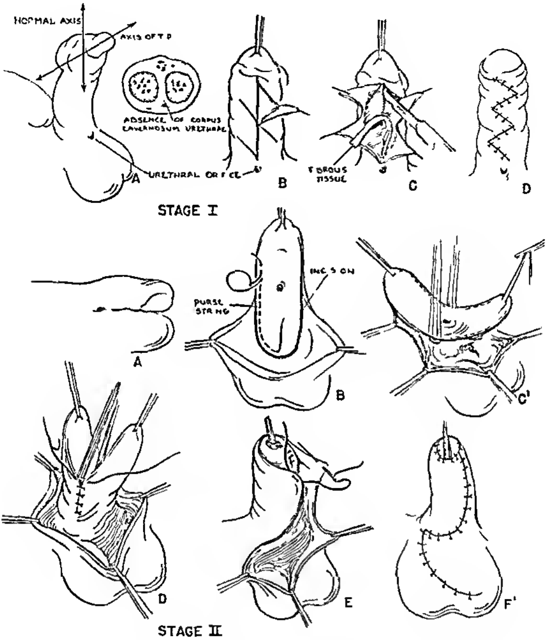

FIG 345 Reconstruction of penoscrotal type of hypospadias (A W Farmer s modification of Ombredanne procedure)

making the operation for epispadias approximate a more genuine plastic procedure (Fig 346)

Young s operation similarly consists of an incision into the dorsal aspect of the penis over the right corpus cavernosum, parallel with the urethral or dorsal groove The skin is then undermined medially so as to form a narrow flap which can be sutured to a similar one created on the left side of the dorsal groove The latter joins the first incision proximally in the region of the pubes This results in the formation of a skin lined tube connected to the opening of the bladder which obtains its blood supply from the region of the left corpus

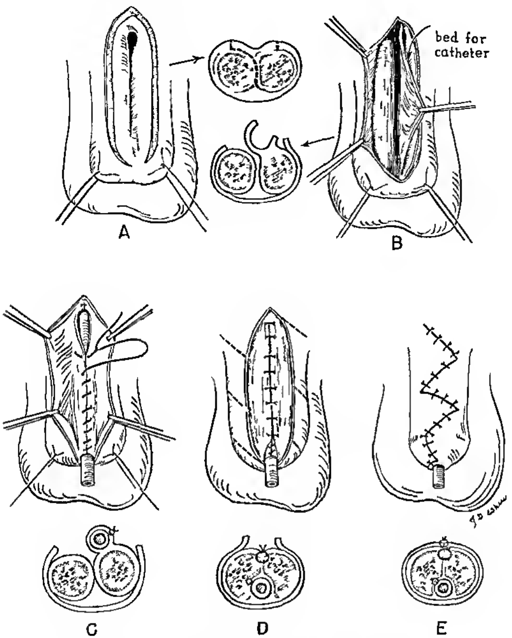

Fig 346 Operation for epispadias (H H Young) with modification of closure Broken lines in D are preparatory incisions to serial Z closure

cavernosum The right corpus cavernosum is then partially avulsed lateralward from the midline so that the skin lined tube can be displaced as far ventrally between the two corpora as possible The lips of the remaining surgical defect consisting of penile skin from the lateral sides of the corpora are then sutured together dorsally as coverage for the newly formed urethra

A slight modification of the closure avoids over all tension and constriction of the penis as well as a straight line closure over the dorsum which leads to a fiddle string elevation of the organ in many cases

The closure then appears as a multiple or serial Z plasty Where the tissue is at a premium—as it usually is in the region of the glans—the redundant ventral foreskin of the penis may be used as complementary coverage by being split into two sheets similar to the procedure employed in hypospadias This allows for the transfer of the upper layer over the corona of the glans and easier closure of the extremity of the newly formed urethra

Many individual attempts by different operators are being made based on better understanding of the principles of plastic surgery for the reconstruction of this condition particularly where it is connected with exstrophy of the bladder These are predicated upon the utilization of tissues extraneous to the deformity which alter proper diversion of the urinary flow allow for more adequate reconstruction Since there has been no standardization in any of these procedures to date it is not felt pertinent at this time nor of benefit to the student to discuss the many plastic surgical approaches contemporarily advanced for the ablation of this unfortunate condition

THE GLANS PENIS Loss of the glans is much more common than loss of the entire penis Like the latter it is more frequently the result of war injuries than civilian accidents In civilian life it is usually the result of burns infectious disease strangulation self inflicted wounds or bites

In war injuries loss of the glans is almost always associated with loss of the contained portion of the urethra whereas in civilian injuries the latter is usually present or only partially injured In any case reconstruction is not impossible The procedure employed by the author in three cases of loss of the glans due to gunshot wounds in the course of battle with gratifying results is therefore cited

All scar tissue of the glans as well as that covering the terminal portion of the urethra is completely but meticulously removed This leaves little but an exposed urethra Bleeding is not severe if a tourniquet is placed about the root of the penis and if the corpora are not perforated. The penile skin is then separated from the underlying dartos muscle by blunt dissection proximally, two-thirds of the distance or length of the body of the penis With this is taken as much of the tissue intervening between dartos and the fascia corpora cavernosa as is consistent with safety to the latter The entire tissue mass is then pulled distally in the form of a sleeve opened inferiorly over the terminal portion of the urethra Two parallel incisions are then made into the tissue sleeve about one half or five eighths of an inch apart so as to result in three flaps two lateral and one dorsal The terminal end of the urethra is mobilized with its spongiosum for a distance of about three-eighths of an inch and held distally by three fine silk sutures one placed ventrally and the other two laterally

When the dartos sleeve is separated into its three flaps one of the lateral flaps is usually considerably shorter than the other This is then drawn over the end of the urethra perforated at that point and the urethra drawn through the perforation The free end of the short flap is then sutured under the peduncle of the longer lateral flap on the other side An interrupted suture anchors the remains of the flap under the peduncle of the dorsal one as well as in the ventral aspect of the penis This provides immediate coverage for the corpora cavernosa The other lateral flap is then brought across the underlying first flap and perforated in the same manner so that the urethra can again be drawn through the second flap The long flap is then draped over the peduncle of the first flap and sutured just above it The dorsal flap which is usually the longest and easiest to handle is brought over the urethral opening in the form of a curtain and perforated in an appropriate place like the other two Again the urethra is drawn through this perforation and held in extension by the assistant The terminus

of the dorsal flap is then anchored to the underside of the urethral spongiosum This results in a fairly bulbous and sometimes surprisingly exaggerated end of the penis

The skin of the penis is then brought down in the form of a sleeve draped about the newly created foundation for the glans and its edges anchored into position circumferentially to the pendúncles of the dartos flaps which are the site of the future corona This should be done with the finest of plain catgut

The lower lip and one oral cheek of the patient are then everted as much as possible and after proper preparation of the mucosal lining of the mouth a free graft of adequate size is dissected from the lower lip and as much of the lining of the cheek as necessary The mucosal defect in the cheek can usually be closed by direct approximation after some undermining Care should be taken not to extend the undermining into the region of the orifice of the parotid duct The raw surface of the lip may be allowed to heal by second intention or may be free grafted if it is felt necessary In that case a stent mould may have to be used

The oral mucosa is then brought into place over the end of the reconstructed penis a perforation made in the graft and the urethra again pulled through it With very fine 8 0 suture material the mucosal graft is approximated to the end of the urethra with extreme care The sutures are left from two to three inches in length While the assistant holds the latter and the penis in extension the remainder of the mucosa is draped over the dartos flaps trimmed and approximated to the penile skin on its ventral side one half inch or more beyond its free edge The skin edge is then rolled under and by means of mattress sutures approximated to its own raw underside This results in a mimicry of the foreskin The mattress sutures are left three to four inches in length

A section of a soft small rubber catheter after being covered by a layer of petrolatum gauze is then placed on each side of the foreskin substitute and the foreskin is splinted between the two segments of rubber catheter by three or four fine mattress sutures The entire penis and reconstruction are now ready for the process of splinting

An appropriate rubber catheter is then inserted into the urethra and passed into the bladder The urethral sutures left long for this purpose are gathered about the catheter under sufficient tension merely to guarantee against retraction of the urethra The sutures are then held in place about the catheter by a circumferential strip of adhesive The mucosal covering of the newly constructed glans is covered by a layer of petrolatum gauze which is then superimposed by humid cotton meticulously distributed over the gauze This is then covered by a layer of moist fiberglass gauze The foreskin sutures are brought down and distributed about the catheter in a manner similar to the urethral sutures but somewhat more distally and also secured in place with a strip of adhesive These may be advanced on the catheter with greater pull than the urethral sutures This results in moderate stretching of the newly formed foreskin forming a collar over the dressing on the glans The two segments of soft rubber catheter splinting the newly formed prepuce are turned ventrally under the penis and their ends are sutured together in the form of two rings

The entire ensemble consisting of the catheter inserted into the urethra the dressings over the newly formed glans and the penis itself are rolled in Xeroform gauze A one inch layer of humid cotton is placed over it This is covered by dry gauze and a one inch gauze bandage is applied A silk suture is inserted through the wall of the catheter near its opening and the ends of the suture are strapped to the thigh by

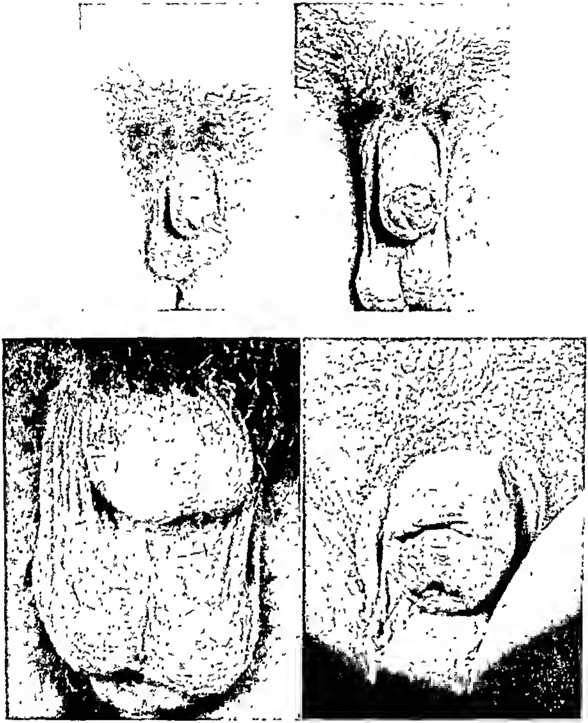

FIG. 347. (*Top, left*) Total loss of glans penis, except small dimplelike remnant of the corpus spongiosum along the left side of the urethral meatus. (*Top, right*) Reconstruction of glans penis completed, 5 months postoperative. Patient is able to urinate without difficulty and has repeatedly enjoyed successful coitus. (*Bottom, left*) Subtotal amputation of the penis. (*Bottom, right*) Construction of glans penis over stump of remains from oral mucosa, with reconstruction of urethra via thick inlay graft. Mimicry of foreskin accomplished by incision, retraction and rolling under of skin covering stump. Skin over root of penis advanced forward through bilateral "pleating" of scrotal skin (see text and also Chap. 21).

means of adhesive After the patient has been returned to bed the end of the catheter is attached to a drainage tube which leads to a *receptacle*

After a few hours the humid cotton, both over the newly constructed glans and over the body of the penis begins to dry sufficiently to become somewhat starchy This plus the anchorage of the catheter to the thigh, acts as adequate splinting for both the reconstruction as well as the penis itself Retraction of the organ cannot occur because of the anchorage of the urethral and the foreskin sutures to the catheter and the catheter to the thigh If erection does occur it is somewhat impeded by the corklike action of the dried cotton over the new glans which is kept from distal displacement by the foreskin sutures distributed over it and anchored to the catheter

The dressings are allowed to remain for a period of from eight to ten days after which they are removed for inspection The penis and the new glans are carefully but adequately cleaned with hydrogen peroxide and saline The dried cotton overlay on the glans as well as the penis may have to be soaked for quite some time with hydrogen peroxide before they can be removed without injury to the underlying glans This is then replaced by dried cotton in the same manner and form as with the original dressing A bandage is reapplied and the entire ensemble is reconstituted to remain in the same position and placement as the original for a period of another week or ten days The urethral catheter as well as the segments of rubber catheter splinting the foreskin may then be removed with all the sutures and spontaneous urination is allowed A secondary augmenting or esthetic procedure on the foreskin may be done six or eight weeks later (Fig 347)

In two out of the three cases operated upon normal copulation without difficulty took place one month and five weeks respectively after removal of the final dressings In these two cases one patient was 19 years of age and the other was 22

Derangements

Segmental Tissue derangements of the penis are of four types those affecting only the skin covering of the penis affections of the corpora cavernosa derangements of the urethra and involvement of the glans

With the exception of scar contractures of the penis and scrotum and the repair of lacerations most of the derangements of the various parts of the organ are adequately treated in texts on genito urinary surgery to which the student is referred In view of the relative difficulties of asepsis in the penoscrotal region most scar contractures at this point are best treated by the Z plasties or the inshifting of collateral flaps wherever possible The principles underlying the correction of scars and contractures in this region are the same as apply anywhere else with the noteworthy exception of special postoperative management because of the implication of erection and the complication of urinary contamination of the repair These again as to management are fully treated in standard modern texts on genito urinary problems

The only tissue derangements pertinent to this text are those associated with scarring of the glans Where such scars are superficial they may be excised and the glansular defect free grafted with oral mucosa

There are many oddities and afflictions of the penis which are so rare that only mention will be made of them One of these is a case of *penoscrotal paraffinoma* reported by Burian of Prague in 1945 The paraffinoma after a protracted period of time was eliminated by Burian through repeated partial excisions of the skin and subcutaneous tissues of the penis and the scrotum The author in his resume of the literature adds that he has been able to find only four other cases of paraffinoma of the

penis and the scrotum in the world's literature With one exception that of Gersuny, they were all the victims of charlatans, who proposed to stiffen the masculinity of the patients by injection of paraffin into the scrotum or under the penile skin

Another oddity is the occasional erotic tattoo seen on the glans Where infection or metaplasia is present the skin of the glans may be excised and the raw surface free grafted with skin or oral mucosa

General Overall derangement of the penis may be congenital or acquired The former is exceedingly rare and usually found in connection with epispadias The latter may be the result of unsuccessful or poorly executed surgery for epispadias or hypospadias More commonly acquired general tissue derangements are the result of burns infections or neglected cases of avulsion The treatment consists of complete scar excision unfurling of the organ repair of the cavernosa where necessary, and skin grafting of the organ in accordance with the methods discussed under Tissue Voids

Excesses

True The common true type of tissue excess affecting the penis is obviously the redundant foreskin in the male and the hypertrophy of the labia minora in the female Both of these conditions are when indicated eliminated by one or another standard form of circumcision

Occasionally but very rarely one may see an example of tissue excesses of the penis such as macrophallus It is doubtful that anyone would contemplate surgical intervention in this condition Diphallic individuals are not unknown but extremely rare Some 30 cases have been reported in the literature For all such conditions including hermaphroditism bisexuality etc the reader is referred to works on genetics and genito urinary surgery

False tissue excesses of the penis consist of elephantiasis and the various and sundry neoplasias including carcinoma of the glans In the latter condition the error is often made (in early cases), of complete amputation of the organ without regard to conservation of the urethra Such outright guillotine exclusion of the urethra is not necessary, as a rule, and certainly precludes expeditious reconstruction Enough of the urethra at the base of the penis should be left behind (½ in) so it can be anchored in the depths of the wound and made available when and if a total phalloplasty is contemplated The establishment of an accurate and dependable juncture between the stump of the amputated urethra and the newly constructed tube is the most difficult and all important part of a successful phalloplasty For anatomic as well as pathologic facts apropos certain conservatism permissible in this connection the reader is referred to texts devoted more specifically to genital organs

VAGINA (VAGINOPLASTY)

Voids

Total The main total void affecting the vaginal canal is so called total atresia of the vagina This may be congenital or traumatic The acquired form of vaginal atresia due to trauma differs from the congenital type (the result of arrested development) in that the former is complicated by the presence of normal uterine appendages The uterus producing menstrual blood in the presence of atresia is unable to dispose of it

Many operations have been suggested and devised toward the correction of this condition All of these may be divided into three types (1) the construction of a vaginal canal from a segment of intestine (2) construction of a vagina from pedicled flaps of collateral tissue (with the labia thighs or abdomen as the donor sites) and (3) the reconstruction of the vagina by free skin grafts

None of the operations thus far devised based upon flaps of collateral tissue or those based upon intestinal transplantation has met with great favor The flap method is rather complicated and in the face of modern advances in plastic surgery unnecessary whereas the intestinal transplantation method is severe and out of proportion to the benefits derived

Most contemporary plastic surgeons are inclined to favor vaginal reconstruction by the use of free skin grafts As a matter of historical interest this method is credited by Neal Owens to Abbe who it is said utilized Thiersch grafts for this purpose as far back as 1898 The donor site was the thigh The main reason why the method has been almost completely abandoned since the time of Abbe is the extraordinary tendency of the thus reconstructed vaginal canal to contract Counseller of the Mayo Clinic reported on 16 operations by this method with excellent results in 15

One of the most recent exponents of the free graft procedure in the reconstruction of the vagina is Neal Owens of New Orleans On the factual basis that most failures resulting from this procedure are due to inadequate postoperative splinting and constant pressure, he has devised a vulcanite form of proper measurements for the primary purpose to distribute adequate and uniform pressure

After making a transverse incision between the urethra and the anus Owens dissects a vaginal canal out between the rectum and the bladder with his index finger He then takes a half thickness skin graft which is wrapped around a smooth vulcanite form whose dimensions are determined preoperatively and the ensemble is inserted into the digitally constructed sinus

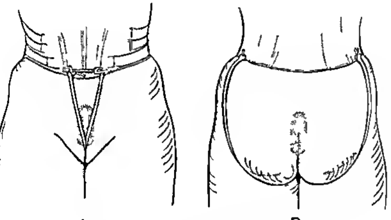

Fig 348 Reconstruction of vaginal canal (Neal Owens) Stippled central area represents prosthesis

The measurements which he recommends for the vulcanite form are from 10 to 12 centimeters in length and 12 centimeters in diameter It is a cylindrically shaped form rounded at both ends with a small knob on the distal end which has two holes in it These holes are intended to carry two rubber tubes which are then attached to an abdominal belt anteriorly and posteriorly (Fig 348)

It is recommended that the patient be kept in bed for approximately ten days after which the form is removed and the new vaginal canal is thoroughly cleaned Following this the vulcanite may be removed daily and douches administered to

the patient, who is allowed to sit up in a chair two weeks after operation It is advised that the patient wear the form for a period of at least six months in order to circumvent the most vulnerable objection to the use of the free graft and that is contracture

The free graft method is a simple one as compared with others and certainly adequate for either congenital or acquired cases In the latter case the vulcanite form may be perforated at its extremities to allow for show of menstrual onset, so that timely hygiene may be instituted The final moderate contracture of a free graft reconstruction of the vagina is not severe enough to compromise the results

Partial atresia of the vagina does occur and is essentially of gynecologic interest The same applies to other types of localized partial voids of the vagina such as fistulae

Derangements

Segmental and General The outstanding derangements of the vaginal canal are lacerations stenoses relaxations and prolapse Adequate descriptions of the treatment of these may be found in recent texts on gynecology

Excesses

True As mentioned before one of the commonest true tissue excesses of the vagina are the hypertrophied labia minora The treatment of this condition is simple circumcision which is invariably curative

False In connection with false tissue excesses of the vaginal orifice the student must constantly bear in mind the many prolapses and ptotic conditions which are met with in women The modern reconstructive treatment of these may be found in textbooks on gynecology

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32

Head (Cephaloplasty)

Cephaloplasties consist of two distinct types the reconstruction of the calvarium (cranioplasty) and plastic procedures upon the scalp (galeaplasty) A true cephaloplasty implies reconstruction of both the scalp and the cranium (compound cephaloplasty)

Deformities of the head necessitating some type of plastic reconstruction may be congenital or acquired The congenital type seldom comes to hand for serious reconstructive surgery because so frequently there is important cerebral pathology with concomitant intellectual involvement precluding the practicability of any surgery

The acquired defects of the cranium for the most part result from accident surgery upon the frontal sinuses and the calvarium proper or gunshot shrapnel or blast injuries in warfare *In any case there may be* extensive loss of bony structure of the cranium In the civilian type of injury there is usually little or no loss of scalp tissue but rather a derangement in the war injury *there is frequently considerable loss* of the scalp

Indications for a cephaloplasty rest upon the necessity for restoration of the protective covering of the brain reconstruction of the contour of the calvarium and restitution of the scalp The patient who knows he has lost some part of his cranium is deeply conscious of the possibility of brain injury and often suffers with a feeling of insecurity only understandable in the light of such a possibility The esthetic importance of the scalp particularly as a hair bearing region and its need for the protection of the calvarium are the important reasons why restitution of its voids or derangements is often necessary

CRANIOPLASTY

Voids

Total The defects of the cranium which are of particular interest to the plastic surgeon as well as of import to the neurosurgeon are voids of the bone These may involve any part of the calvarium from the supra orbital ridges anteriorly to and including the occiput posteriorly Complete accidental loss of the calvarium is a rarity but injuries approximating a hemicraniectomy are not unknown in war (Fig 81)

Partial Attempts at the replacement of missing portions of the calvarium are known to have been made centuries ago The materials employed range from biologic substances such as cartilage and bone to inert materials of various kinds such as vitallium plates silver plates (which sooner or later become oxidized) gold plates glass *tantalum* and the acrylics Most recently M Hunter Brown J H Grindlay and W McK Craig have presented promising clinical as well as experimental evidence of the superiority of Polythene over other inanimate materials Polythene is a synthetic thermoplastic resin belonging to the category of paraffinic hydrocarbons According to Brown et al Polythene is remarkable by virtue of its extreme chemical inertness * These authors state that it fulfills the criteria of a dural substitute and

* Brown M H Grindlay J H and Craig W M The use of polythene film as a dural substitute Surg Gynec & Obst 86 663 1948

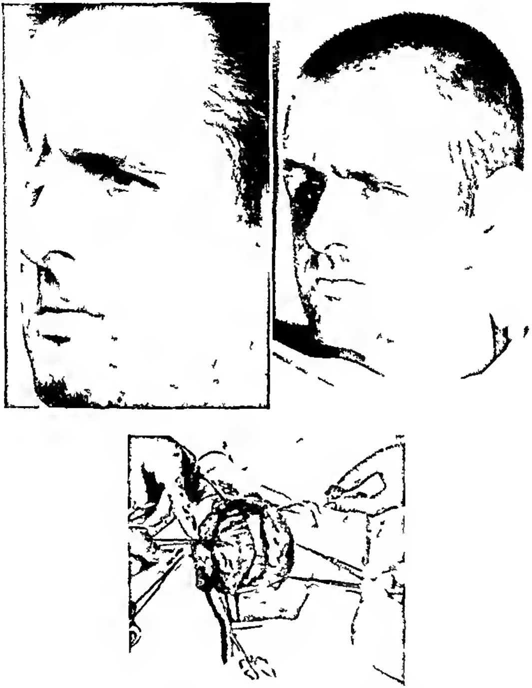

Fig 349 (*Top left*) Preoperative semiprofile view of frontal and orbital injury (*Top right*) Same 6 months postoperative following bony reconstruction of forehead and orbit in one surgical inning (*Bottom*) Showing advisability of separate bone graft for reconstruction of supra orbital rim (see text) Note latter wired into position Bone graft for forehead being insinuated above the new supra orbital ridge

does not form adhesions to the lepto meninges or cortex

Cartilage Autogenous as well as homogenous cartilage has been successfully employed in the correction of voids of the cranium Autogenous cartilage is preferable

and may be secured from the rib cage of the injured patient It may be employed as a one piece graft or in the form of diced or ground cartilage It may serve its purpose well for relatively small defects of the cranium particularly in the supra orbital region but is not adequate for the reconstruction of larger defects of the calvarium elsewhere When used at all it is preferable in one piece grafts because otherwise it has a tendency to gravel lump and result in undesirable esthetic surface defects under the skin Finally it is not an adequate protection for the brain

Bone as a graft for extensive defects of the calvarium is one of the oldest most adequate and satisfying substances to use The source of bone for this purpose may be the rib the tibia or the ilium

Since the greater number of telling defects of the cranium are those afflicting the forehead the inner table of the ilium lends itself best for this type of repair A fairly well-developed ilium particularly in the male may yield sufficient bone for the reconstruction of the entire forehead The graft is obtained by carefully splitting the thickness of the ilium so that approximately the inner one third to one half of its thickness is removed for the repair The normal shape of the average ilium is such that the inner concavity is quite easily adaptable to the bulge in the underlying brain The graft is placed over the dura with the raw surface of the iliac bone outward This is then covered with the overlying scalp

Since most extensive voids of the forehead involve part or all of one (or both) supra orbital ridges the reconstruction for esthetic reasons should be based upon two separate bone grafts One a bony bar for the supra orbital ridge should be taken from a selected portion of the iliac crest This is then wired into position to the naso frontal region medially and the zygomatic laterally, in such a way that its arched contour is on a level with the uninjured supra orbital ridge on the other side Only after this has been satisfactorily accomplished is the remainder of the frontal region grafted using the supra orbital ridge as a keystone for the contour of the remainder of the forehead (Fig 349) A well executed and successful bony reconstruction is superior in every respect to the easier and less adequate methods of repair by inanimate substances such as the metals

Vitallium which is an alloy of molybdenum cobalt and chromium may be used as a preformed casting or in the form of strips It is mentioned here simply to emphasize that it has and may be employed for this purpose but has certain obvious disadvantages such as its weight difficulty of shaping and manipulation its possible erosion of bone and finally the danger of temperature conduction to the brain substance

Tantalum With the advent of World War II considerable interest arose in connection with the use of the rare metal Tantalum for the repair of large cranial defects It may be obtained in sheets of varying thicknesses It is far easier to work with than vitallium because of its malleability ductility and its lighter weight It has the additional advantage of being easily hammered to shape at the operating table without the need for preoperative casting (Figs 350 and 351)

Acrylics are substances known under such trade names as Lucite Plexiglas and many others all belonging to the class of plastics Acrylics have certain

Fig 350 (*Top left*) Lateral view of skull following battle injury showing amount of bone loss of forehead right orbital and frontonasal region (*Top right*) Same illustrating communication between cranial fossa and nose via frontal sinus brought out by Lipiodol injection (*Bottom left*) Repair of frontal bony defect by perforated tantalum plate Communication between cerebral fossa and frontal sinus closed (*Bottom right*) Six months postoperative Showing formative reconstitution of forehead

Fig 351 Protruding tantalum plate *following reconstruction of forehead* There were no associated complications Note single perforation in tantalum plate and no evidence of tissue growth through it The soft tissue defect was firmly adherent to the tantalum plate so that no communication existed between the outside and the cranium

advantages over other inert substances because they seem to be better tolerated by tissues They are firm and strong and are not radiopaque as are the metals The acrylics are even somewhat lighter than the bone that they are intended to replace They are far more difficult to work and shape than tantalum and like vitallium necessitate almost a special set up in the operating room for adequate shaping Ultimately the fate of acrylics may go the way of ivory because of the inherent hardness of the substance This is an important factor in subsequent accidental injuries to the reconstruction which in the case of ivory almost invariably results in extrusion of the substance

Derangements

Segmental These may be congenital or acquired The former are for the most part dystocias of no practical consequence to the plastic surgeon The acquired derangements are in the main healed fractures whose reconstruction is seldom necessary except in connection with cerebral pathology For osteoplasties in this connection the student is referred to texts on neurosurgery

General Overall derangement of the calvarium may be congenital or acquired The congenital type is of little practical surgical interest because of the frequency of concomitant cerebral pathology The acquired type is the result of bone disease or severe injury The former means removal of the portion involved by neoplasia and its substitution by materials mentioned under Voids The latter is less liable to come to operation except insofar as the case may be of primary neurosurgical interest If bone removal is necessary at that time the case is then dealt with as a bone void

Excesses

True Bony excesses of the calvarium range from duplication of one of the bones composing it to the two headed monsters In any case surgical interference is not practical or necessary as a rule

False These constitute an array of conditions mainly composed of exostoses and neoplasms For the surgical management of these cases the reader is referred to texts on general surgery and neurosurgery

THE SCALP (GALEAPLASTY)

The scalp is of even greater importance to the plastic surgeon than defects of the cranium proper This is so because of the esthetic import of the scalp in our everyday lives particularly the life of a woman It is not the loss of the scalp as a skin covering for the underlying cranium which is so important but because of its hair bearing quality and the desirability of the latter in our society Obviously what skin is available on the body is never adequate in its hair bearing capacity to supply that spe

FIG 352 (*Left*) Practically total avulsion of scalp with exception of an island of tissue over occiput Case seen 5 weeks after avulsion Caused by rotatory machine Coronal aspect of right frontal bone and part of parietal were completely denuded of periosteum but still viable (*Right*) Same patient 10 months postoperatively Note excellent condition of graft (full thickness) covering head The hair growth in the occipital region denotes island of scalp spared at time of accident (Case referred by Dr Frederick Slobe) (See also Fig 134)

cialized aspect of the scalp The restricted exceptions to this rule are the axillary and pubic regions Although the skin of these regions could conceivably be transferred to the head, it is not a practical contemplation because the quantity of skin in any case is not sufficient to cover an entire head and the quality of hair is far different than may be acceptable

Voids

Total Total loss of the scalp is not rare in industrial injuries It usually results from the entangling of a woman s hair in some type of revolving machinery which by sudden pull, coincident with the counter twisting of the victim's head, results in elevation of the calvarial portion of the scalp With further twisting of the head laceration occurs over one of the bony ridges of the cranium, eventuating in complete scalping of the victim s head The loosely woven subaponeurotic layer permits easy and immediate avulsion once the scalp has been lacerated at any point (Fig 352 *left*)

Avulsion of the scalp is usually total in the sense that little of the covering of the calvarium is left beyond part of one temporal region or the suboccipital region Laceration and loss of part or all of the forehead with one or both upper eyelids and occasionally part or all of one ear is a frequent concomitant The trauma may be shocking and attended by large loss of blood Hence the most important immediate single factor in first aid treatment is control of hemorrhage

The scalp, being a complex organ, does not lend itself to free replacement after total avulsion Cases are on record of such

attempts The results are always the same —gangrene and sloughing of the scalp Unless the avulsed tissue can be retrieved in a clean state, handled sterily, shaved and separated into a thick outer split graft, with abandonment of the deep tissues, there is no point in attempting to restore the scalp to its original site This is never made possible to the plastic surgeons, because such cases are first seen by the general practitioner or industrial surgeon The avulsed scalp tissue is usually lost sight of or mishandled at that time

After control of the hemorrhage, if the case is clinically clean and the general condition of the patient permits, the denuded area may be covered with a thin split graft as a temporary if not permanent biologic dressing otherwise the open wound must be treated until such a time as one is certain of its clinical cleanliness with clean granulation tissue present, whereupon the raw surface may be covered by thick or full thickness skin grafts If a full thickness skin graft is employed, as in the case illustrated (Fig 352) ultimately a fuzzy or lanugo type of covering will appear, depending upon the normal hair content of the graft No further growth of hair can be anticipated (See Chap 2 Biophysiology of Grafts)

Not infrequently with total avulsion of a scalp much of the underlying cranium is exposed as bare bone The procedure commonly employed in such cases is to drill the outer table of bone into the more vascular diploic layer whereupon granulations are allowed to grow out through the drill holes before grafting is attempted This type of management is relatively time consuming technically complicating and ultimately unnecessary If the bone is clean and uninfected it may be drilled and covered immediately, coincident with the coverage of the remainder of the head by the skin graft with a fair degree of success When the drill holes are immediately covered by skin, the granulations from the diploe will appear on the surface of the outer table with much greater rapidity

If the skin graft is cut so as to by pass the denuded bone, it is difficult to maintain the graft around that area because there is nothing to which to anchor it by suture If the area is covered and if the skin graft overlying it should not survive the surrounding area of graft lying upon already present granulation tissue will have taken hold and so maintain its place and integrity by the time the skin overlying the bare bone has sloughed

A total avulsion of the scalp should be grafted at one sitting if the general condition of the patient permits it This makes the problem technically easier and ultimately results in a far better esthetic appearance The average case of total avulsion of the scalp will need from 70 to 100 square inches of skin Once the entire cranium has been covered and the physiologic integrity of the new scalp is assured, the latter must be protected for a period of at least 60 days against any form of trauma before the patient is allowed to wear a hat or even a peruke (alteration) During this period of 60 days or more the patient should be advised to keep the new scalp covered during the night with cocoa butter cream and a linen skull cap or beret so as to avoid desiccation and too early exfoliation of the epidermis

Partial Partial avulsions of the scalp are comparatively common If the avulsed portion of the scalp is still attached to the remainder by a substantial pedicle it should be sutured back in place after shaving the entire head It should be managed post operatively in the same way as a pedicle flap Where the avulsed portion of the scalp has been totally lost the denuded area should be covered as early as possible by a split or full thickness graft In due course of time if the area was not too large, as the split graft shrinks because of the depo

FIG 353 (*Left*) Unavoidable derangement of the hairline the result of large scalp flap swung down to cover an extensive defect of forehead and left orbit Forehead buttressed by tantalum plate (War repair done elsewhere) (*Right*) Revision of hairline by extensive Z plasty 5 months postoperative Note still existing subtotal void of left supra orbital rim The latter is best repaired by a bone graft (see Fig 349)

sition of fibrous tissue under it it may be partially excised in repeated operations until the surrounding good scalp can be shifted in flapwise to cover the grafted area If the location of the partial avulsion is in the region of greater elasticity of the scalp it may be possible to close the defect by appropriate flaps rotated into it from the surrounding good scalp (see Fig 134)

Derangements

Segmental Aside from the scalp derangements from burns lacerations and scars the most annoying one to the victim is distortion of the hairline This usually can be remedied by some type of tissue rotation or Z plasty (Fig 353)

Alopecia is a very common concern Where the etiology is not amenable to medical management and the condition is not universal it may be presented for surgical consideration The small area of alopecia may be excised and the defect covered by rotating or sliding flaps of contiguous scalp tissue

The transplantation of individual hairs to the scalp is not unknown but a rather questionable process both from the standpoint of results as well as labor The transfer of hair bearing skin to the head from the region of the hairy chest or the axillae has also been tried It is not a practical procedure because of the element of time involved and the amount of surgery necessary Finally the hair from any other part of the body is not as a rule satisfactory on top of the individual s head

Where only the coronal part of the scalp is afflicted with alopecia and a zone of hair remains circumferentially about the head the latter may be transferred in the form of flaps to the top of the head to mimic a more

extensive hair growth This is not possible by simple shifting of the scalp because the latter is not as elastic as the skin in other regions of the body The designing of the flaps is entirely dependent upon the extent of the hairy zone remaining about the region of the temples and the occiput Whatever raw areas remain must then be free grafted or covered by the rotation of flaps upward from the neck region

Excesses

True excesses of the scalp are exceedingly rare and demand simple excision of the gyrate and redundant scalp with closure

False excesses of scalp tissue in the form of neoplasms and cysts although comparatively common, are usually subject to simple excision and closure

The only difficult false tissue excess of the scalp the surgeon meets with occasionally is the extensive cavernous hemangioma This, with the exception of the reconstitution of the hairy aspect of the scalp may be managed in accordance with the criteria discussed under Hemangioma of the Face Ligation of separate vessels supplying the hemangioma is, in many cases, helpful in expediting ablation of the undesirable tissue

COMPOUND CEPHALOPLASTY

Occasionally extensive avulsion of the scalp is associated with partial losses of the underlying cranium and vice versa If this type of injury is also associated with extensive laceration of the dura, the latter, particularly at the time of original repair, may be the most difficult phase of the surgery Many substances have been used in the accomplishment of repairs of the defects of the dura, foremost among them fascia When the latter is employed, it is used according to the same principles applied in the repair of perforating abdominal voids

Certain inanimate substances have been employed for this purpose, among them Cellophane, as reported by De Bernardis,* who claims thus to have avoided adhesion between the brain substance and the overlying skull Bruening recommends splinting of the dura into two layers, allowing the outer leaf to remain attached to the periphery of the dural defect on one side and suturing its free incised edge, after rotation, to the other side of the defect

A D Ecker more recently reports several successful cases of closure of the dura by pedicled flaps of pericranium He dissects the skin and galea aponeurotica, leaving the pericranium behind, covered by the subgaleal connective tissue The pericranium is patterned, incised and elevated as a second flap and insinuated between the defect and the overlying bone, so that it extends well beyond the dural defect The author states that 'sutures are usually unnecessary, because the weight of the brain holds the graft in place, but they may be used, especially at the base of the graft to prevent its displacement' † The original scalp flap is then replaced in its bed, flush with the skin surface

Where there is coexistent bone loss and absence of pericranium, M Hunter Brown et al recommend the use of "Polythene" mentioned at the beginning of this chapter

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33

Jaws (Gnathoplasty)

This outline of the reconstructive surgery of the jaws is by no means intended to give the student complete guidance and information on the subject, but rather a basic knowledge of the principles involved in the management of injuries and defects of the facial bones so that he will be better prepared to understand more extensive treatises in this connection The subject is so extensive and specialized as to therapy that entire texts are devoted to this phase of plastic surgery alone Therefore the student is referred for details to the more specialized texts

Injuries and defects of the jaws can be the most implicating problems in the sphere of reconstructive surgery The face is the keystone to the most important basic functions of the human organism With the exception of excretion and regeneration the facial orifices being so dependent upon the underlying bony form are the most vital in man s relationship to his environment It is in them more than elsewhere that the integrity of form determines to a major degree the efficiency of function (Cf Chap 23 Esthetic Surgery)

In gross facial injuries the otologist ophthalmologist rhinologist the dental surgeon neurosurgeon and others must stand en rapport with the plastic surgeon The patient with a grossly mutilated face though he may be brought to see hear taste smell to chew and swallow never will consider the efforts in his behalf and the results worth his suffering unless he looks human again Barring the accomplishment of the latter the patient is relegated to a vegetative existence In the attainment of this final formative result the plastic surgeon finds his greatest usefulness

Categories of Jaw Injuries

Topographically jaw injuries are divided into two main categories defects of the mandible and those of the maxillary region The former is not difficult for the student to understand since it implicates one more or less specific bone the mandible On the other hand so called maxillary or middle third of the face fractures actually involve several bones They are the lacrimal sphenoid vomer zygomatic arch malar nasal ethmoid the maxilla proper the palate and the alveolus It is only rarely that so-called maxillary fractures are solely confined to the maxilla itself Blair in discussing injuries to the upper jaw states

> Considered in relation to fractures the term maxilla includes all the bones of the face with the exception of the frontal bones and the mandible—all together including the lacrimal and the lateral masses of the ethmoid vomer and parts of the sphenoid forming one integral mass in which fracture lines disregard anatomic boundaries *

Because of the complex nature of maxillary fractures it is helpful for the student to picture so called middle third of the face fractures as zonal fractures Apropos such a designation Z stands for zygoma O for orbital compound N for the nasal compound A for antral or strictly maxillary fractures and L for the lingual implications that is the alveolus and the palate Thus in the analysis of injuries of the middle third of the face and the plan

* Blair V P and Ivy R H Essentials of Oral Surgery ed 3 St Louis Mosby 1944

FIG. 354. (*Left*) Traumatic tissue derangement, profile view. (*Right*) Same, profile roentgenogram. Note extensive loss of mandible

ning of treatment, the designation "zonal" may act as a mental blueprint of procedure. More specifically, if a patient presents himself with a left maxillary fracture with involvement of the "malar-zygomatic compound," the plan of treatment may be noted as consisting of the $(Z)(O)N(A)L$ type.

MANDIBLE

VOIDS

Total voids of the mandible, as such, are rare except in warfare. Such an injury implies much more than mere loss of the mandible. The associated soft-tissue destruction of both face and neck presents problems in reconstruction for which an adequate solution is as yet lacking from the kinematic standpoint. Lexer, in the first edition of his *Wiederherstellungs Chirurgie*, mentions two attempts at total reconstruction of a mandible. In one roentgenogram, appearing on page 86 of Lexer's work, lack of detail makes it impossible to say whether the reconstruction is actually total or subtotal. He fails to offer evidence as to the ultimate results obtained

For the present. total voids of the mandible are only amenable to surgical camouflage or artificial prosthetic substitution.

Partial voids of the mandible may be minimal, involving one centimeter or less of the bone, or they may be so extensive as to involve almost the whole mandible. Unilateral complete loss of the mandible is not unusual in warfare Bilateral extensive losses are also not rare under such conditions. The most telling partial void of the mandible, from a functional standpoint, is that involving the symphysis The loss of one ramus of the mandible is not an uncommon occurrence. This involves very seriously the function of mastication be-

FIG 355 (*Top left*) Soft tissue derangement consequent upon subtotal loss of right mandible External appearance in these cases often belies amount of scar tissue present subcutaneously (*Top right*) Planned flap dissection of soft tissue defect with exposure of large mass of fibrous tissue represented by light area surrounding fracture site in right mandible (*Bottom left*) All scar tissue surrounding fracture site of mandible has been excised Note adequate amount of soft tissue present for temporary closure and partial reconstruction of form pending bone grafting of mand bular void (*Bottom right*) Three weeks postoperative Note repositioning of mouth and relative absence of soft tissue retraction following extirpation of scar tissue Also observe closure by cervical rotation flap Following complete tissue organization (minimum of from 6 to 8 weeks) bone graft of mandible can be done Tantalum bar to span bony void may be used as interim splint

does not compare in actual severity with the loss of the symphysial portion of the lower jaw *Because of the unavoidable loss* of soft tissue associated with loss of the symphysis such patients drool constantly and are unable to eat any solid foods The *remaining portions of the mandible* are drawn inward to such a degree that they

often interfere with swallowing The resultant deformity is very obvious and sometimes grotesque (Fig 354 cf also Fig 32) In complete loss of the symphysis the acute displacement of the tongue and hyoid muscle compound may be of such severity as to result in death from suffocation Hence under conditions where adequate immediate splinting of the jaws is not possible as in warfare a tracheotomy is the best precaution against such an eventuality

Finally such voids are almost routinely associated with considerable soft tissue destruction within the mouth resulting in extensive fibrosis contractures and adhesions between the tongue and the remaining portions of the mandible There may be considerable interference with speech Losses between the angle and the symphysis are the least deforming and usually attended by minimal complications

Treatment The first aid or original treatment of voids of the mandible though exceedingly important can only be summarized within the scope of this text They consist of immediate arrest of profuse hemorrhage and treatment of shock In very extensive losses of the lower jaw the need for establishment of an adequate airway may even supersede the importance of the treatment of shock Recognizance at this time must also be had of the associated injuries of other facial bones and of the possibility of a skull fracture

The next important step in the management of these cases is the adequate and reliable splinting of the remains of the lower jaw The methods employed for this purpose will be discussed presently under Derangements

The reconstructive surgery of mandibular voids may be divided into five phases (1) dental hygiene (2) scar excision and splinting of the freed remnants of the lower jaw (3) re establishment of the lining of the oral cavity (4) bone grafting and deep soft tissue repair and (5) esthetic surface reconstruction The severity of the void and

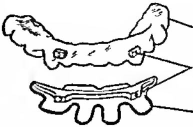

Fig 356 Dental splint with carrier for wire to which can be attached a stent mold for buccal inlays Note undulations in wire This allows for projection shaping and extension of wire parallel with needs of new buccal sulcus and size of stent mold

certain complicating factors determine whether or not the five phases shall constitute five separate surgical innings

The institution of adequate dental hygiene in gross destruction of the mandible is important because either prior to the trauma or coincident with it certain dental derangements occur which are frequently followed by infection loosening of teeth and accumulation of debris any one of which may act eventually as a potential source of danger

Gross insult to the jaws always results in considerable external scarring These scars frequently contain inclusion foci of pus which may or may not be sterile It is not rare in the excision of extensive scars associated with such injuries to run into large cold abscesslike pockets Both scar and pus must be completely eliminated before bone reconstruction The excision of the scar tissue serves a second purpose namely the return of misplaced tissues to more nearly normal position and release of bone fragments Without it replacement of the remains of the jaw and pre reconstructive splinting is impossible thus preventing ultimate restoration of the bite (Fig 355)

To maintain the released bone fragments to avoid subsequent distortion and to condition the oral cavity for dental prosthesis the lining of the mouth must be restored To this end all scar tissue within the oral

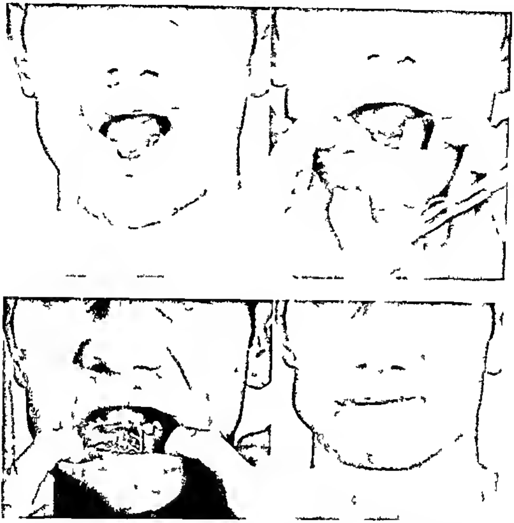

FIG 357A (*Top left*) *Deformity of lower lip alveolus and obliteration of buccal* sulcus due to fracture derangement of mandible (*Top right*) Note acrylic splint prepared for attachment to the few teeth remaining The splint serves a twofold purpose as prosthesis for absent alveolus and as carrier of wire support for stent mold to be fitted into new buccal sulcus (*Bottom left*) *Acrylic splint in position and* attached to teeth Note undulating wire still in original position Note undulations in wire which permit latter to be bowed downward into buccal sulcus at time of operation (*Bottom right*) Appearance of patient with stent mold covered by split skin graft in position on wire shown at left and now projected into stent lying in new buccal sulcus

cavity must be excised and replaced by split skin grafts In this connection the aid of the dentist is invaluable The dentist must prepare the necessary impressions and molds from which adequate dental splints are then manufactured to act as carriers of molds either stent or acrylic which in turn act as carriers for the split skin grafts (Figs 356 358) After all the scar tissue is excised intra orally and a healthy raw bed is reached the skin graft is wrapped around the stent or acrylic mold and inserted into the depths of the wound This arrangement is maintained for a period of from eight to

FIG 357B Details of acrylic splint (see Fig 357A *top right*) Wire intended as carrier for stent mold is out of sight because of its attachment to inferior aspect of splint

twelve days during which time circulatory communion is usually established between the graft and its surrounding bed The skin graft wrapped and sutured around the mold is then incised so that the mold may be removed and the graft cleaned and inspected After the new lining has been dried the mold is reinserted and may be removed as frequently as every day for hygienic reasons It must be returned and maintained in position for a period of at least one month to obviate shrinkage of the new lining

In the excision of scar tissue consequent upon extensive gunshot wounds of the face it is not unusual to find a large number of foreign bodies metallic wood glass vegetable or otherwise which must be removed or the risk will remain that the repaired bed never will be adequate for a successful bone graft

Six weeks or more after removal of the scar tissue and release of the bone fragments the mandibular void may be filled by a bone graft (Fig 360)

Some authorities in spite of the advantages of chemotherapy nevertheless advocate a routine waiting period of three to six months Although there is no substitute for good surgery the six month period is not recommended in cases progressing well because of the possible secondary soft tissue derangements resulting from absence of bony support These after late grafting make kinematic rehabilitation much more difficult Bone grafting should be delayed as long as necessary but done as early as possible consistent with the specific problems peculiar to each case The calendar should never become a yard stick to bone grafting any more than chemotherapy should become the determining factor of surgical management The ultimate guides should always be the signs of physiologic integrity of the injured part

In jaw grafting one may use rib iliac bone or a tibial graft If the loss is minimal (2 centimeters or less) and involves the region anterior to the masseter a sliding graft pedicled on the platysma (Cole s procedure) may be employed (Fig 359) The costal and iliac sources are the most commonly and undoubtedly the best employed for the mobilization of bone grafts for the jaw Some surgeons prefer one and some another In general it may be said that for the average mandibular void the iliac crest is the more easily accessible and gives adequate material for reconstruction Where the mandibular loss involves both the body and the ramus the mobilization of a combined cartilage and osseous graft from the seventh the eighth or the ninth ribs opposite to the side of the fracture or bone void may have a certain advantage This resides in the fact that where there is extensive loss of the coronoid process or the condyle or both a short cartilaginous end on the bone graft may be more easy of shaping and implantation into the temporomandibular space

The amount of bone which may be lost in the mandible with the possibility of restoration of the masticatory power varies in different individuals and depends on the degree of destruction of the muscles of mastication as well as other collateral tissues As long as sufficient mandible is present bilaterally which still enjoys attachment of some of the muscles of mastication there

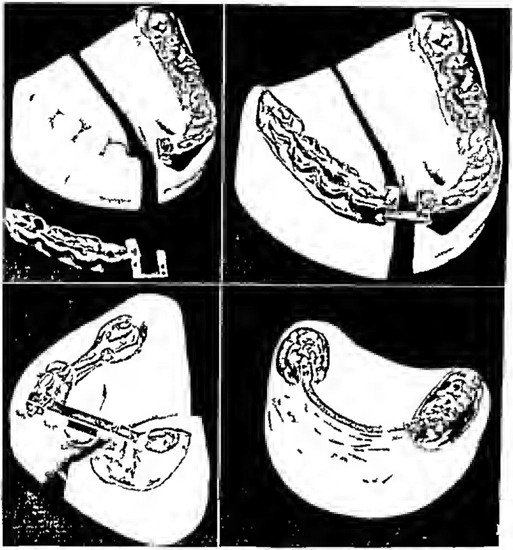

FIG 358 Certain splints for defects of the jaw bones (*Top left*) Splint with locking device for fracture displacements of jaw bones (*Top right*) Splint and locking device assembled (*Bottom left*) Dental splint with adjustable bar particularly useful in bony voids of mandibular symphysis (*Bottom right*) Dental splint with bar attachment and acrylic carrier for buccal inlays useful in cases of mandibular voids in region of symphysis with loss of the buccal sulcus This type of splint is particularly useful where much of the alveolus has been lost (see Fig 357)

is a fair chance of success in the extensive reconstruction of the mandible and the rehabilitation of the masticating powers The adequate replacement of these remaining stumps of the mandible in the course of scar excision and soft tissue revision is an important factor in the subsequent rehabilitation of the individual The recognition of *this factor to a large degree is entirely up* to the plastic surgeon whereas the maintenance of the position of these fragments may depend entirely upon the adequacy of the oral splinting which follows and should be relegated to the hands of a competent dental surgeon (Figs 358 and 361)

The type of splint most appropriate for

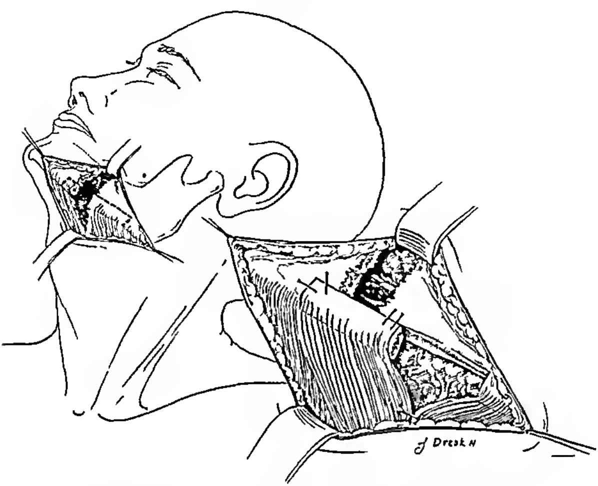

FIG 359 Pedicled mandibular sliding bone graft for moderate defects of mandible The bone graft is left attached to the platysma at time of operation (Cole)

the maintenance of the fragments depends first of all upon the presence or the absence of teeth If teeth are present, a simple bar splint securely fastened to the remaining teeth will be adequate (Fig 358) Where no teeth are present in the remaining man dibular fragments the teeth of the opposite jaw may be used as secondary points of anchorage for alveolar saddle splints fash ioned out of acrylic or metal The impres sions are taken from the alveolar ridges of the remaining portions of the lower jaw The splint which bears impressions of the teeth of the apposing jaw is then secured to the jaw and the injured jaw is insinuated into the inferior impressions on the splint The two jaws are maintained in apposition by either external or internal forces or by both These splints if properly constructed may act as interim prostheses until the soft tissue reconstruction is completed so that it conforms to the ultimate formative needs of the bony jaw itself

The soft tissue reconstruction of the area about the mandible is based upon two needs an adequate lining for the oral cav ity and covering soft tissues necessary to good form If the loss of the lining tissue within the oral cavity is extraordinary this may have to take the form of a pedicle flap of skin usually turned up and into the mouth from the neck the shoulder or the pectoral region If one of these regions furnishes the lining for the mouth its con tralateral mate may be made to furnish the external covering for the lower jaw The

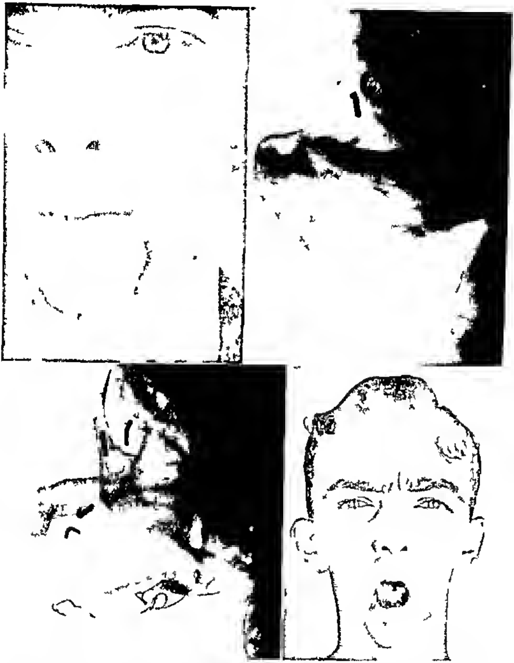

FIG 360 (*Top left*) Deformity of left jaw and chin due to extensive bony void of mandible (*Top right*) Preoperative roentgenogram showing extent of mandibular void (*Bottom left*) Postoperative roentgenogram showing iliac bone graft in position (1 year postoperative) (*Bottom right*) Function of mandible one year after extensive bone grafting of void in left jaw and soft tissue revision

necessity for using skin flaps in the restoration of the lining of the mouth is more prone to occur with extensive losses in the region of the symphysis (See Chap 34 Lips and Mouth)

The amount of bone necessary in the

FIG 361A (*Top, left*) Facial dystocia due to extensive loss of left maxilla and almost total void of right mandible Deformity of mouth due to original repair done on the battle front Note cervical depression due to vertical tracheotomy wound (*Top, right*) Detailed roentgenogram of small remains of right mandible At operation only a condylar fragment, measuring ½ inch in length, was found to be present This was considerably atrophied, thinned out and surrounded by much fibrous tissue (*Bottom, left*) Surgical exposure of void in right mandible with gross form of iliac graft intended to replace lost mandible Shaping of bone graft was done before insertion Note very small light area in left extremity of wound, all that could be found of the condylar extremity of mandible (*Bottom, right*) A method of splinting of extensive bone graft of right mandible Note wire in preauricular region projecting from depths of face This is attached to the juncture of bone graft with condyle and perforates both This was found necessary because remaining fragment of the condyle was so displaced, rotated and deeply buried that, to maintain its surgically replaced and normal direction it had to be splinted externally via the wire attachment showing in preauricular region (see Fig 361B)

restoration of a mandibular void must be equal to the amount of bone loss sustained Exact determinations are based on roentgenograms and measurements taken during excision of the scar tissue at the time of soft tissue revision as compared with the normal form of the mandible on the other side Where the lateral bulge in the lower jaw at the angle is prominent normally a much more extensive bone graft will be

FIG 361B (*Top*) Same patient 2 years postoperative Note formative balance and convexity of right side of face as well as mouth (photographed minus denture) (*Bottom left*) Same observe prominent convexity of iliac graft and still retained stainless steel wire sutures including imbedded portion of wire originally supporting remains of condyle The most convex portion of left iliac crest was chosen in this case because of the normal convexity of patient s left mandible This proved an important factor in the final formative results obtained (*Bottom right*) Lateral view of subtotal bone graft of right mandible two years postoperative

necessary than is implied by the length of the void In these cases the crest of the ilium opposite to the loss is usually a better source of material than the rib

Mandibular voids following elected resection of the lower jaw may result postoperatively in a marked degree of regeneration Kazanjian has recently reported a case of spontaneous regeneration of bone following excision of a large section of the mandible for ossifying fibroma Such cases emphasize the many factors involved in the phenomena of bone regeneration and growth as well as the factors involved in bone grafting The amount of bone removed in this case extended from the middle of the ramus posterosuperiorly and as far as the canine region anteriorly Kazanjian attributes the unusual amount of bone regeneration to the fact that the resection of the bone was made possible by stripping the periosteum * The regeneration took place in six months He adds that the mobility of the mandible did not seem to prevent regeneration

The matter of the replacement of soft tissues in as nearly their anatomic position as possible and particularly those directly related to chewing at the time of insertion of the bone graft is an important factor in determining the ultimate functional result As indicated in Chapter 16 the restoration of normal muscle balance about the injured jaw has much to do with the ultimate results of bone grafting Finally whether in resections or grafting unless the soft tissues are replaced in normal anatomic position the formative results will not be satisfactory

In spite of all diligent efforts made at the reconstitution of a grossly injured mandible the ultimate esthetic results may not comply with plan or expectation because there is no certain way of anticipating amounts of tissue shrinkage and maintenance of elasticity This may necessitate secondary revisions with complements of skin fascia or subcutaneous tissue For this purpose the transportation of fat via a tube as indicated in Chapter 26 Cheeks is an invaluable detail in procedure

For further details in connection with the reconstruction of mandibular voids the student is referred to texts which are devoted in their entirety to this extensive subject The amount of work done and knowledge accumulated in connection with this phase of plastic surgery has been so extensive in World War II that it is not possible in this general volume to do any more than outline the principles and the problems underlying the question of procedure in reconstructive surgery of the jaws

* Kazanjian V H Spontaneous regeneration of bone following excisions of sections of the mandible Am J Orthodontics 32 242 248 1946

Derangements

Segmental The cardinal derangements of the jaws of vital importance to the student and the general surgeon are fractures of the jaws certain conditions of the temporomandibular joint and such rather uncommon conditions as the receding chin or microgenia

Fractures of the mandible may be unilateral or bilateral single or multiple simple or compound As to frequency of location they run in the following order fractures through the angle the mental foramen molar region symphysis condyle and coronoid

Where the general practitioner and the student are concerned it is probably not an exaggeration to say that the question of jaw fractures precipitates a feeling of mystery and bewilderment for two reasons the principles of oral surgery are sadly neglected in the medical curriculum and the oral surgeon has thrown a kind of halo of mystery about the treatment of jaw fractures So much is made of methods of approach and details of fixation of jaw fractures that the student is often left unimpressed by the fact that the principles of

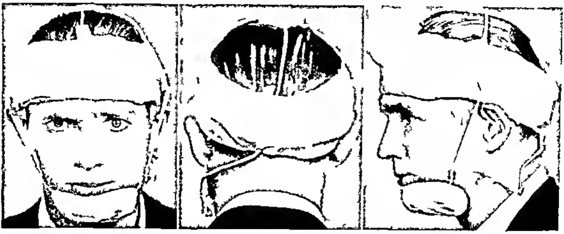

FIG 362 (*Left*) Basic method of immobilization of double fracture of mandible via plaster headgear In this case there was a fracture of the symphysis without displacement and a fracture of the angle of left mandible with moderate displacement of proximal fragment upward This type of splinting is best complemented by interdental wiring (*Center*) Posterior view to illustrate course of heavy wire used for attachment of elastic traction on rotated mandibular fragment (*Right*) Lateral view of headgear and chin attachment with elastic traction on mandibular angle

orthopedics apply as well here as they do to the extremities *In other words a fractured bone no matter where it is should* be realigned in a functional position In connection with the jaws this should be almost easier for the student to grasp and understand than in the instance of the injured hand *There is no such accurate guide* in the management of complex fractures of the extremities as the teeth in connection with the jaws Therefore at the risk of over simplification it is important for the student to remember that where teeth are present *in the mouth and a jaw fracture* exists the proper realignment of normal tooth relationships (in other words the reconstitution of a normal bite) is the best general guide to procedure in the management of jaw fractures

This may be accomplished in one of several ways If there is no displacement of the fractured ends simple bandaging (Barton Sling) may suffice Otherwise some more direct realignment of bone and tooth relationship either internal (intra oral) or external (*extra oral*) *must be employed* (Fig 362)

This guiding premise of course is absent in the edentulous jaw On the other hand *some teeth always are present in the apposing* jaw This may be used as a basis for the delineation of an acceptable formative reconstruction of the edentulous jaw An available plate in the latter is simply aligned with the uninjured jaw

By virtue of the relationship of the jaw bones to the contaminated oral cavity and the presence of teeth within the jaws an obvious (and at least potential) complicating factor always exists—infection from a tooth in the line of fracture In principle if a tooth *in the line of fracture obviously* acts as a potential irritating or infective factor the tooth should be removed Secondly if the tooth present in the line of fracture is of good timber and its removal from the standpoint of trauma may add insult to injury *watchful waiting for a* period of several days may be the more intelligent procedure When honestly in doubt remove the tooth (Fig 363) If the tooth in the line of fracture happens to be the only one in that jaw and if it is not *obviously so loose as to* preclude survival it may be retained in the hope that it will act as a point of fixation for intra oral

FIG 363 (A) Lateral roentgenogram showing tooth in line of fracture (B) Postoperative

splinting With the recent advances made in chemotherapy, greater latitude of management is allowed at this point without the need for extensive external drainage Certain unirrupted teeth in or near the line of fracture are also allowed to remain because their extraction would only add insult to injury The additional surgery may finally be the one avenue of infection

With the foregoing statements as a basic denominator the general care of fractures of the facial bones may be said to consist of unhurried and unprecipitated action A thorough study should be made of each individual case through satisfactory roentgenograms and dental x rays From these the amount and the type of displacement can be ascertained often leading to intelligent interpretation of the coexistent soft tissue injury and particularly of the muscles of mastication This in connection with determination of the probable normal relationship of the lower to the upper dental arch establishes the basis for intelligent treatment Tooth relationship is a problem for the dentist who in these conditions is of immeasurable help to the surgeon

In compound fractures of the mandible certain unavoidable procedures consistent with good original repair must be met First of all is the adequate care of coexisting facial wounds involving the soft tissues and the removal of debris Loose pieces of the jaw which are completely detached from the periosteum and therefore have no hope of establishing circulatory communion with the rest of the bone should be removed before any thought of reduction Foreign bodies loose pieces of bone as well as teeth displaced into the depth of the fracture are one of the commonest causes of subsequent osteomyelitis (Fig 364) Where concomitant soft tissue injuries are extensive a drain may still be advisable for a period of from four to six days until chemotherapy and incipient healing have established a cause for hope of repair without complications

Methods of Fixation An adequate diagnosis being made and infection and other complications having been ruled out one of many procedures for the functional reposition of the fractured mandible is employed All these procedures may be divided into direct fixation intra oral and extra oral fixation of the fracture

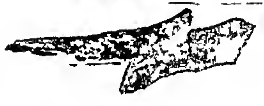

FIG 364 (*Top, left*) Large foreign body in line of fracture of left mandibular angle buried in the pharyngomandibular fossa All such foreign bodies must be extracted no matter how difficult if bony repair is to be anticipated and ultimate infection avoided Small comma shaped foreign body below fracture was in the subcutaneous fatty tissue and therefore not removed at the time (*Top right*) Roentgenogram 5 months after removal of foreign body Note bony regeneration in fracture area Clinically patient had a more formidable jaw than appears from the X ray (*Bottom right*) Outer surface of removed shell fragment Note fish hook type of foreign body (½ actual size) This made it exceedingly difficult to remove Hook was the deep end (See also Fig 80)

So called internal wire fixation of jaw fractures and wire suturing has been recommended by J B Brown S D Gordon and others Brown recommends it for difficult jaw fractures and states that open reduction has almost been eliminated and complicated dental appliances are avoided'* In commenting on the use of stainless steel wire in the direct approximation of bone fragments Gordon states that the wire has remained in place in spite of soft tissue infection—its use has allowed of accurate reduction being fixed locally, and in the case of the mandible has been invaluable in controlling fragments that otherwise would be difficult to manage † J B Erich and L T Austin comment that it is generally accepted that open operations for reduction or fixation of fractures of the jaws too often end in osteomyelitis necrosis of bone or nonunion Consequently if osteomyelitis is to be avoided we believe that open operations are never to be undertaken one should rely on and should have enough ingenuity to construct intra oral or external appliances which do not require surgical exposure of the line of fracture but which

* Brown J B and McDowell F Internal wire fixation for fractures of the jaw Surg Gynec & Obst 74 227 230 1942

† Gordon S D Wire suturing in the treatment of facial fractures Canad M A J 48 406 409 1943

supply adequate immobilization of the fragments of the jaw *

On the premise that the insinuation of foreign material into an already damaged tissue and the addition of surgical trauma to accidental injury only increases the physiologic insult to the part open procedures, although they have their place in selected cases, are not recommended for routine use by the occasional operator and should therefore be left to the discretion of the expert

External immobilization of fractures of the mandible consists of the use of appliances such as the so-called Roger Andersen fracture assembly Credit for this appliance is given by Ivy to Brig-Gen Leigh C Fairbanks and Col Roy A Stout, of the Dental Corps, U S Army Ivy s conclusion in connection with the use of external appliances of this type is as follows, 'briefly put, the only indication for use of the method in the mandible is in our opinion, the control of fragments where teeth are absent or do not afford adequate attachment for intra oral appliances Under these circumstances, it is extremely valuable' †

The Fairbank Stout assembly, manufactured by the Roger Andersen Company, is a form of clamp attachment to a series of pins which are drilled into the bone fragments These pins are then influenced by the attachments as levers through the medium of which the fragments of the fractured mandible are moved into as near anatomic position as can be verified by palpation and roentgenograms These appliances, when used in the case of the mandible, as in the case of the bones of the extremities are not without risk Secondary infection or bone necrosis cannot be entirely ruled out Nevertheless, in selected cases, as indicated by Ivy, they are extremely valuable

The intra oral methods of fixation, although not the easiest to apply with understanding are undoubtedly the most nearly accurate procedures applicable to the treatment of fracture of the mandible This may consist of simple direct wiring of the teeth of the lower to the related teeth of the upper jaw, so called single loop intermaxillary wiring, or by the application of continuous wire loops to the teeth of both the injured as well as the uninjured jaw The two are then apposed by separate wire loops or rubber bands spanning the distance between the related teeth of the two jaws

The basic objection to the single wire loop is that it throws too much force against one or a few teeth The use of the so called hooked arched bars over the teeth of the entire unaffected jaw and separate bars to each fragment of the injured jaw results in better distribution of force of splinting and consequently less chance of injury to individual teeth The arched bars are then apposed by elastic rubber bands placed over the related hooks between the two jaws Where only individual teeth are present in the affected jaw, so called anchor clamp bands may be used, which with a buccal sheath, are attached to the individual teeth and may then be incorporated in the ensemble with rubber bands in the same manner as indicated under arched bars Where few teeth are present both in the affected and unaffected jaw immobilization may be impossible because of the difficulty of applying loop wires or hooked arched bar whose security of attachment always remains questionable In such cases anchor clamps or wire loops may be placed upon whatever molars are present and round wire arched bars as a kind of theoretical substitute for the missing teeth are spanned between the molars present The rubber bands or wires used for direct apposition of the two jaws may then be applied over these bars (Fig 365)

Where there are no teeth at all one may have to resort to previously prepared acrylic splints and circumferential wiring of the mandible or external fixation of one form or another The latter may be unavoid

* Erich J B and Austin L T Traumatic Injuries of Facial Bones Philadelphia Saunders 1944

† Ivy R H and Curtis L Recent experiences with skeletal fixation in fractures of the mandible J Oral Surg 1 296 308, 1943

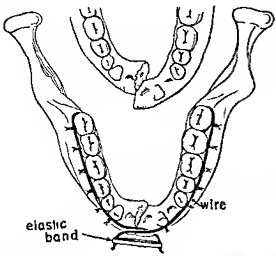

Fig 365 (*Top*) A useful intra oral method of separating an overriding fracture of the mandible particularly in the region of the symphysis Two arms of heavy wire are wired to the teeth with their free ends projecting over the fracture site bent as indicated and then connected by a rubber band which by virtue of its pull on the wire bands separates the overriding fracture (*Bottom*) Roentgenogram illustrating healed overriding fracture of mandibular symphysis the result of inept interdental wiring

able in fractures through the angle of the mandible where the posterior fragment consists mainly of the vertical ramus which is always displaced upward and inward into the oral cavity One of the oldest and sometimes most satisfactory methods of controlling the posterior fragment is to make a buttonhole incision externally over the angle identify the posterior fragment drill a small hole through it and after inserting a loop of wire close the soft tissues with two or three sutures and attach to the wire loop a rubber band The latter is then hooked over a heavy bent wire incorporated in a head cap The constant elastic traction of the rubber band will eventually pull the displaced posterior fragment into apposition with the body of the mandible With proper intra oral splinting satisfactory results may be obtained (Fig 362)

With fractures higher up than the angle that is in the region of the condyle usually no other treatment is necessary than immobilization of the mandible for a period of from three to four weeks The ideal open operation for the anatomic replacement of the condyle is seldom necessary A false joint sooner or later develops at the site of the fracture which rarely interferes with adequate function of the jaws Where the condyle is rotated laterally to such a degree that it is easily noted or palpated in the preauricular region the mouth should be opened widely (by force if necessary) and by means of a strong substantial needle the fragment of the condyles is pushed inward While it is held in position the mouth is allowed to close and the two jaws are apposed by a few loops of inter maxillary wires Where no teeth at all are present in either jaw a Gunning splint must be inserted and the lower jaw apposed to the upper

When seen early before malunion has occurred repositioning fixation and early recovery should be possible in every face fracture but the correction of a malunion is at best a complicated procedure too often followed by an imperfect result *

The Temporomandibular Joint Certain common conditions of the temporomandibular joint are of interest to the student surgeon Foremost among these is the so-called 'clicking jaw This is frequently associated with recurrent displacement and dislocation of the mandible when

* V P Blair personal communication

the patient opens his mouth. This condition may be the result not necessarily of a disease of the joint but purely the consequence of injury to the periarticular ligamentous structures as a result of forcible depression of the mandible as sometimes occurs during general anesthesia. Following this the patient notices some tenderness in the joint, clicking and eventually accidental subluxation which may or may not recur depending upon the habits and the temperament of the individual.

Many treatments are recommended for this condition including various surgical procedures none of which have been consistently reliable or gratifying. Sclerosing and shrinkage of the periarticular tissues by injection of various substances such as dilute tincture of iodine or sodium morrhuate have been used with some degree of success. Probably the best treatment for this condition has been that advised by L. W. Schultz and J. W. Shriner who recommend the use of sodium psylliate known by the trade name Sylnasol.

The injection is made with a 1 or 2 cc syringe and a 24 to a 26 gauge needle approximately 1½ inches long. After cleaning the preauricular region with ether and alcohol one asks the patient to open and close his mouth so that the condyle can be identified in its excursions. Finally the patient is asked to keep his mouth open and the needle is pushed through the skin into the glenoid fossa in an inward, forward and upward direction until it strikes the dome of the fossa. This is a distance of 2 to 3 centimeters depending upon the quantity of soft tissue overlying the temporomandibular joint. The needle is then withdrawn about 0.5 centimeter and ten drops of a solution of Sodium Psylliate in 2 per cent procaine (1 to 3) is injected. These injections are repeated at two-week intervals until sufficient fibrosis develops about the joint in the periarticular tissues to result in stabilization. If the injection is successful the patient will usually return for his second treatment with the report that the clicking has stopped, that the jaws feel more tense and secure although the patient still harbors the fear of dislocation. After three or four injections the patient usually will return with the information that in chewing the joints feel unusually stiff. At this juncture the patient is encouraged to open his mouth as widely as possible several times, thereby reassuring him that the treatment has been successful. As a rule this amount of therapy is adequate in controlling the integrity of the joint.

The opposite condition of the former is ankylosis of the mandible. This may be bony, fibrotic or inflammatory.

Whereas inflammatory ankylosis usually subsides with the disappearance of the infecting agent, the bony or fibrotic type eventuate as surgical problems. The bony type of ankylosis demands direct attack upon the temporomandibular joint. Various types of procedures are recommended, all of which ultimately can be reduced to the common denominator of resection of the condyle with or without interposition of extraneous substances, organic or otherwise.

The fibrotic types of ankyloses usually the result of gross injury to the mandible and the related bony and soft tissue structures dictate complete excision of the fibrous tissue with ablation of the raw surface by some type of free graft. The old practice of simple transection of the fibrous bands obviously has been no more satisfactory than transection of any other type of fibrous contracture. Incisions into scar tissue only generate more scar tissue and recurrence of contracture.

Where fibrous ankylosis is very extensive, removal of the fibrous tissue and attempted intra-oral free grafting is usually inadequate if not unsuccessful. In such instances through an intra-oral incision the entire coronoid process is exposed and resected after stripping the temporal attachments to it. The wound is closed, drained and followed by external pressure dressings.

Microgenia. Marked retrusion of the mandible is the result of interference with

the normal growth of the lower jaw eventuating in malocclusion and lack of prominence of the chin There are two basic types the one where the recession is of a degree amenable to orthodontic treatment and the other necessitating surgical intervention Recession of the lower jaw is probably not the development of the maxilla as well as the backward expansion of the posterior cerebral fossa and the occiput and its effect upon the development of the lower jaw

When the condition of microgenia is established and orthodontic treatment obviously is of little help complementary

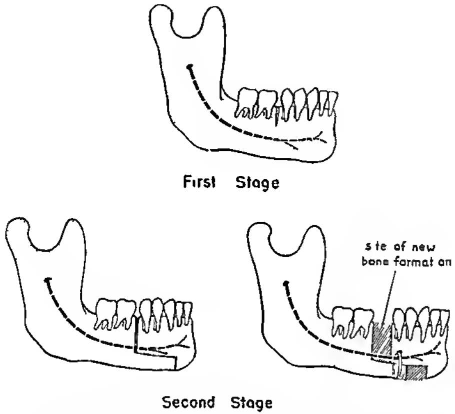

Fig 366 A two stage procedure for the correction of retrusion of the mandible without severing the alveolar nerve (Dingman) The first stage showing a bone cut down to the alveolar nerve is done intra orally The second stage is done extra orally (See text for one-stage procedure also Fig 370)

due to malocclusion but rather the cause of malocclusion The embryologic and developmental genesis of jaw derangements of this type are complicated and technical and would serve the student no useful purpose in the comprehension of associated esthetic reconstructions Their ultimate causes are the result of the complex mechanism of growth of the forebrain and its effect upon surgery may be indicated This may be divided into three types the buttressing of the condyle posteriorly with cartilage thus forcing the mandible forward sectioning of the mandible and upholstering under the soft tissues of the chin The first is a comparatively extensive and traumatic procedure of questionable integrity The second consists of one or another type of transec

tion of the body or ramus of the mandible with deliberate forward dislocation of the distal fragment (Fig. 366). The limitations of this procedure reside in the fact that the mandible very often is so short that even an oblique incision through its body is not sufficient to allow for adequate displacement of the anterior fragment of the mandible with maintenance of bony contact.

The upholstering of the chin between the mandible and the soft tissues may be accomplished by means of cartilage, bone, or inanimate materials. Cartilage, whether homogenous or autogenous, is employed most frequently because it is easier to carve and somewhat more easily imbedded. On the other hand, cancellous bone taken from the iliac crest is a more reliable material from the standpoint of durability and not much more difficult to shape than cartilage and certainly easier to manipulate than cortical bone taken from the tibia or the rib. The latter is also subject to considerable absorption in due course of time, so that cancellous bone serves the purpose far better (Fig. 367).

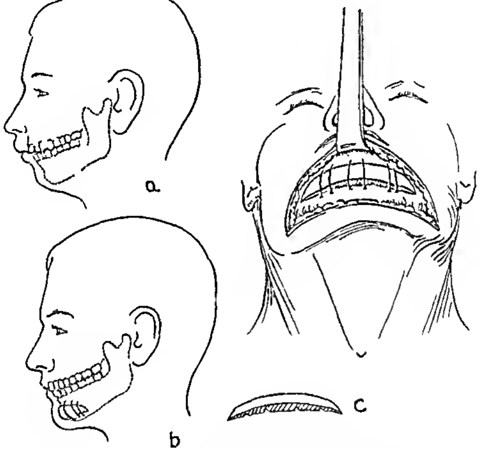

FIG. 367. A method of correcting microgenia by an onlay graft of bone or cartilage.

An incision is made under the chin down to the periosteum of the existing symphysis; the soft tissues are elevated, and the periosteum is incised and stripped back for some distance. The wound is then packed to assure hemostasis, and one of the iliac crests is exposed as a donor site. The required amount of cancellous bone is mobil

ized shaped and applied to the denuded symphysis of the mandible with chromic or fine stainless steel wire sutures To attain good formative results one must not only make certain to place sufficient bone over the symphysis but an adequate amount tapered on each side of it so that the chin becomes not only prominent in a forward direction but well proportioned to the angles of the jaw in an anterior view (Figs 367 and 368)

The traumatic generalized derangements are basically such comminuted injuries as involve different segments of the mandible on the two sides Their management consists of the combined applications of individual procedures used in segmental derangements

Excesses

True Prognathism The main condition of the mandible classifiable under true ex

Fig 368 A case of microgenia corrected by an iliac onlay graft

General Overall general derangements of the mandible though not uncommon may be congenital or traumatic The former are more frequently seen in private practice than the latter which are more peculiar to war injuries The congenital forms of general dystocia are so uncommon and their treatment is so involved that it is not practical within the scope of this text to attempt a reasonable discussion The derangements consist of a long array of conditions ranging from exaggerated bilateral apophysis lemurica to bilateral dysplasia of the entire jaw

cesses is the so called protruding chin or mandibular prognathism True prognathism must be differentiated from pseudoprognathism which is the result of an unreduced horizontal fracture of the superior maxilla The latter after being driven backward heals in that position and results in an apparent forward protrusion of the mandible

As with all reconstructive procedures both form and function must be considered This is imperative in the correction of prognathism since to reduce the protruding chin without accomplishing a distinct improvement in the bite would be to jeopardize a

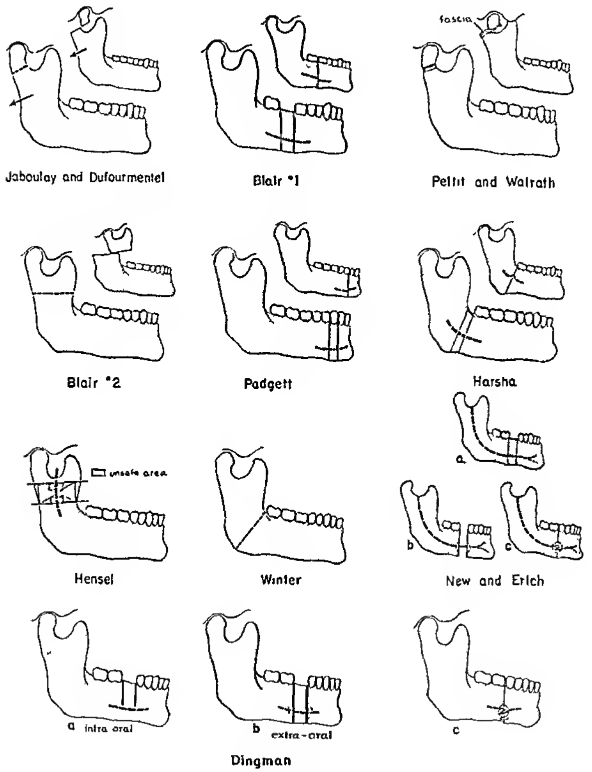

FIG. 369. Various surgical procedures employed in the cure of prognathism (after Dingman).

basic function The procedures employed for the ablation of this condition are many All can be reduced to (1) bilateral *resection of segments of the mandible* near the angle the bicuspid region, or in the molar regions, (2) bilateral osteotomy through the necks of the mandible or through the ascending rami just above the mandibular foramina (3) removal of the condyles *These resections may be done as a* one stage procedure, or they may be done as a two stage procedure, thus avoiding contamination of the wound or infection of the bone from oral secretions and conserving the alveolar nerve and vessels (Fig 369)

Recently Bingham has reported on a series of fourteen cases, stressing the advantage of the two stage procedure From my experience I see only one advantage Where teeth have to be sacrificed in order to remove a segment of mandible a partial intra oral section of the jaw may be done at the same time The inferior half of the mandible is sectioned subsequently through an external approach

The difficulty with this advantage is that the original intra oral incisions into the mandible may not coincide as easily with meticulous extra oral calculations as one would wish This results from the greater difficulty in accuracy with making of the intra oral mandibular incisions As a matter of fact with a properly angulated periosteal elevator (its sharp end bent at more than 90°) and a meticulous subperiosteal external resection of the jaw, little fear need be had of perforating into the mouth unless the operation is undertaken too soon after extraction of the teeth Where no teeth are present initially the integrity of the periosteum should be sufficient guarantee against intra oral perforation (Fig 370)

The various methods of approach all have certain advantages as well as disadvantages It is fairly well agreed that the resection of segments of the mandible from its body (Method No 1) is the best controllable method of the three Resection of the condyle is not adequate for correction of a major protrusion Transection of the ramus endangers the facial nerve and the internal maxillary artery, as well as the parotid gland

Before resecting the mandible a certain amount of preliminary planning must be done The designing of a splint which will guarantee not only the stabilization of the *resected mandible but* an adequate post operative bite is the initial problem The simplest method is to take preoperative impressions of both jaws determine by measurements and exclude that portion of the mandible bilaterally which it is intended to resect, mount the sections remaining on an articulator and then construct cap splints which will guarantee correct apposition of the teeth after operation These cap splints are applied before operation and then locked or wired together after completion of the resections New and Erich recommend a waiting period of 24 hours before locking of the intra oral appliance, to obviate post operative interference with respiration in cases done under general anesthesia This should be a routine precaution where more than ⅜ of an inch of mandible is resected bilaterally The one disadvantage in this precaution is that where the nerve has been conserved as it should be it is liable to loop out from its position within a prepared pocket within the medullary interior of the bone and become compressed or pinched off when the mandibular fragments are apposed the following day A compressed nerve takes longer to regenerate sensation than a cut one which lies duly apposed within the canal

If the body of the mandible is to be resected the teeth in line with the segment to be resected (if present) are extracted bilaterally This may be done three or four weeks before the operation An incision is then made on each side under the lower border of the mandible in the submaxillary region and the jaw is completely exposed subperiosteally in the area to be resected

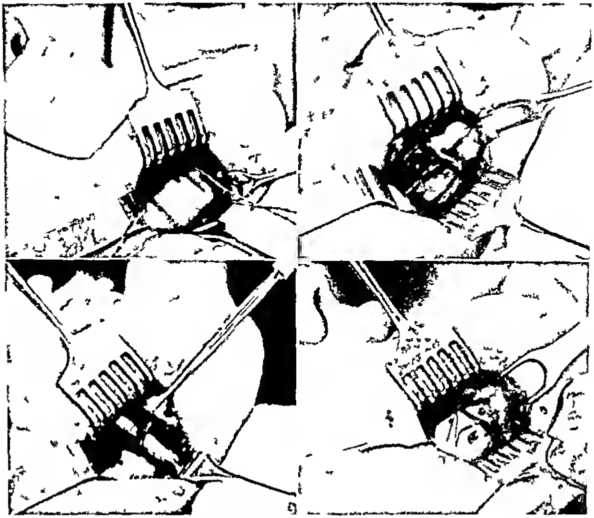

FIG 370 One-stage reduction of prognathism (*Top left*) Mandible exposed subperiosteally through one inch submandibular incision Two Gigli saws encircle mandible without perforation into mouth (Teeth are absent in this section of jaw) Note partial cuts into mandibular cortex to indicate extent of excision (¼ in) Distally placed Gigli saw has made two cuts for purpose of illustrating difference in size of left and right segments to be removed The shorter segment (⅛ inch) to be removed from left jaw This is often necessary because of unequal protrusion of the mandible on the two sides The Gigli saws cut only down to nerve canal are then turned up at right angles so as to cut inner table of jaw up to nerve canal Anterior saw has already accomplished both as shown (*Top right*) Outer table of mandible has been removed with dental burr exposing mandibular nerve lying in its canal Note inner table of mandible still present Also observe wire holes already drilled in anterior jaw segment (*Bottom left*) Inner table of mandible removed leaving nerve uninjured and spanning void between jaw segments For contrast a cotton applicator tip has been inserted under the nerve Note wire holes drilled in proximal jaw segment Before apposing mandibular segments the spongy interior of mandible is curetted out to make room for the nerve (*Bottom right*) Mandibular segments being pulled together by wire sutures The nerve buckles into curetted interior of mandible With excision of large sections of mandible (over ⅜ in) it is advisable to postpone wire apposition for 24 hours or do temporary tracheotomy to avoid asphyxia due to posterior displacement of oropharynx

If the two stage operation is to be performed, the first stage consists of the intra oral exposure of the mandible with double incision of the bone to the extent of the resection down to the alveolar canal A period of three to five weeks is then allowed to elapse whereafter the external approach is made This begins in the same manner as the single stage type of resection Once the proper amount of mandible has been resected bilaterally (provided that the operation was done under block and local analgesia) the lower jaw is splinted to the upper for a period of three or four weeks Following this the jaws may be separated, and an arched bar is applied across the teeth of the lower jaw for another month to guarantee protection of the resected jaw

Hyperplasia of the condyle of the mandible may be resolved by resection of the condyle This is followed by re establishment of proper occlusion and eventual return of bilateral form Very few cases of true condylar hyperplasia have been reported The cases made available are those of Werrig Ivy, Eiselsberg J W McNichol Kaplan and Brown

Other true tissue excesses of the mandible consist of localized or segmental enlargements of the mandible Such conditions demand resection of the offending segment consistent with the establishment of a normal bite and good appearance

False The main false excesses of the mandible are represented for the most part by tumors These may be primary or secondary in the lower jaw They cannot with consistent accuracy be diagnosed simply by x rays Biopsy is indispensable to accurate diagnosis Many classifications of mandibular tumors have been evolved foremost among which is that of Waldron and that of Byars * The latter is more simple and probably of easier service to the student

I Tumors of dental origin
   A Follicular cyst (single and multiple)
   B Dentigerous cyst
   C Ameloblastoma (pre ameloblastoma)
   D Radicular cyst (or granuloma)
II Tumors of nondental origin
   A Primary mandible
      1 Benign
         a Giant cell
         b Eosinophilic granuloma
         c Fibroma
         d Traumatic
      2 Malignant
         a Carcinoma (local spread)
         b Sarcoma (fibrosarcoma osteogenic sarcoma Ewing s)
   B Secondary in mandible
      1 Metastatic sarcoma and carcinoma
      2 Altered body metabolism
         a Hyperparathyroidism
         b Lipoid disturbances (Gaucher's Christian Schuller etc)

The use of x rays is most valuable in delineating the extent and the area of involvement of the mandible rather than as a final diagnostic criterion This is due to the fact that so many neoplasms of the mandible both primary and metastatic are multilocular and roentgenographically resemble one another

Aside from the common so called dentigerous cysts of the mandible a rather frequently occurring and interesting condition is the so-called ameloblastoma It is a neoplasm which develops from the cells of the enamel organ and therefore may be found in the maxilla as well as the mandible It has been found in the ulna the ovary, the tibia and the pituitary gland It may be present at birth or as late as the eighth decade It is purported to be a benign type of neoplasm although according to a study of 379 tumors by Robinson '4 5 per cent showed metastasis or histologic evidence of malignancy' Most of the recurrences in connection with the removal of ameloblastoma are undoubtedly due to inadequate

* Byars L T and Sarnat B G Mandibular Tumors Surg Gynec & Obst 83 355 363 1946

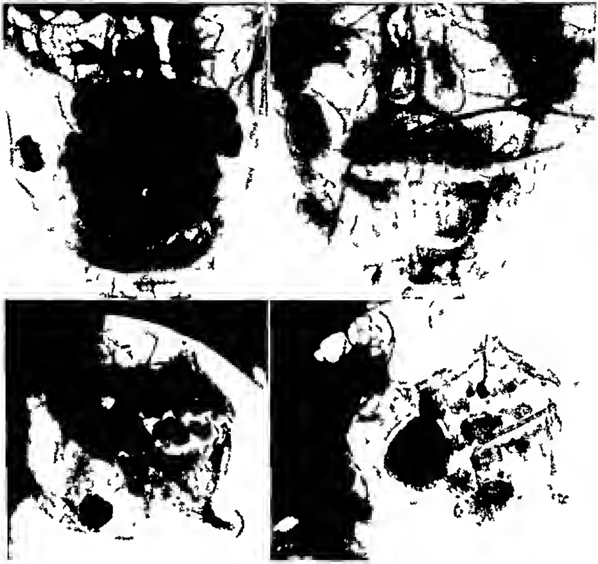

FIG 371A Roentgenogram of an extensive ameloblastoma of the right mandible in a patient 19 years old (*Top left*) Inclusion of molar in the cystic neoplasm (*Bottom left*) Lateral roentgenogram of ameloblastoma of right mandible (*Top right*) Following injection of ameloblastoma with iodized oil Catheter can still be seen in position in cavity of ameloblastoma inserted through opening remaining after removal of incisor tooth Difference in shadows between iodized oil and outer wall of ameloblastoma denotes actual thickness of lining of the cavity Constriction in iodized oil shadow denotes almost complete separation of ameloblastoma into two locules (*Bottom, right*) Lateral roentgenogram Note constriction in shadow At operation only a very narrow communication was found between the two extremities of the ameloblastoma (Fig 371B)

surgical removal in the first place (Fig 371)

X ray treatment of the ameloblastoma is of no effect Local surgical excision of all identifiable tumor tissue is usually adequate This is particularly true in cases where the tumor has not altered the contour of the mandible to any appreciable degree Where an extensive involvement of the mandible is present or where the tumor has gone beyond the confines of the lower jaw, radical resection must be done Frequently,

FIG 371B Extensive ameloblastoma (*Continued*) Roentgenogram showing the mandibular cavity after removal of molar tooth (see Fig 371A) and complete enucleation of ameloblastoma

the tumor may be removed or shelled out from within the confines of the mandible as any cyst might be The remaining void must then be obliterated by the insinuation of available soft tissue in the vicinity Following resection some form of splinting of the remaining portions of the mandible must be done The wound is closed with drainage and subsequent reconstruction anticipated

Such fixation of a resected mandible may be accomplished by the conventional intra oral interdental wiring or by an external appliance Most recently the tendency has been toward so called internal bar fixation of the mandible This may be accomplished through the medium of metal bars of tantalum stainless steel or arched bars the ends of which are wedged into the apposing segments of the lower jaw The last method is undoubtedly the easiest to accomplish and dispenses with all the intricacies and mechanical difficulties associated with both intra oral and extra oral stabilization of the fragments

THE MAXILLA

Voids

Total voids of the maxilla in civilian practice are rare In warfare they are not unusual They result in gross deformity of the face, usually associated with considerable loss of soft tissue and the orbit and are extremely difficult to reconstruct When a total maxillary void exists and if the soft tissues overlying it are also absent these tissues are replaced and the remaining intra oral defect is free grafted Against this free grafted area a prosthesis is inserted previously designed so as to maintain adequate formative appearance of the face The prosthesis is so designed as to be attachable to the contralateral maxilla and its teeth It is not an entirely satisfactory reconstruction The complicated process involved in the making of the prosthesis is not within the scope of this short volume The student is referred to more extensive works dealing solely with the making of prostheses

A classic illustration and management of this type of case (the result of a war injury) and associated with total loss of the nose was reported by Barsky* The coverage and lining for the middle third of the face were provided by a lined forehead flap (hammock type) which was swung down over an acrylic denture constructed preoperatively This gave support to the lined flap and gave profile to the face The lining of the oral sulci was reconstituted by free skin grafts wrapped over stent molds The nose was constructed from the center of the flap by appropriate secondary flaps to form the alae and columella

Partial voids of the maxilla usually consist of loss of the external wall of the antrum frequently associated with loss of the alveolus or the palate on the same side The depth of the defect may be filled by a temporal muscle flap as suggested by Gillies or by an appropriate tube pedicle Later a bone

* Ann Surg 118 992 994 1943

graft from the ilium may be inserted as suggested by Figi and a proper dental appliance made to complement the teeth of the normal maxilla

H Hoyle Campbell has recently described a method for the ablation of an extensive maxillary void by obliterating the depths of the wound with the anterior third of the temporal muscle on the affected side Coincidentally he transposed the mucoperiosteum of the unaffected side of the palate to the injured side to separate the mouth from the nasal cavity At a subsequent operation two months later an extensive iliac graft was mobilized and fashioned Through an infra orbital incision on the affected side the skin the subcutaneous tissue and the facial muscles were reflected from the underlying temporal muscle (formerly inserted into the depths of the maxillary void) and whatever accessible bony surroundings of the defect including the right alveolus were exposed The shaped iliac graft was then wired into position over the temporal muscle flap thus reconstituting the anterior and lateral walls of the maxilla This likewise provided a surgical substitute for the lost alveolus on the injured side Two months following the second procedure an incision was made into the buccal mucosa along the outer border of the bone graft more or less imbedded in the upper lip This incision was deepened upward and backward to mimic a labial sulcus This was free grafted with abdominal skin and after healing had taken place a preformed dental appliance was inserted The results in the case both functional and cosmetic seemed to have justified the procedure

Derangements

Fractures The management of maxillary fractures may seem quite complicated to the student for two reasons the first cited under introductory remarks to this chapter is that most maxillary fractures are actually zonal involving other bones of the middle zone of the face besides the maxilla proper (Fig 372) and the second is the numberless appliances described in connection with the immobilization of the fractured maxilla For purposes of easier comprehension so called maxillary fractures were divided into zygomatico orbital (ZO) naso antral (NA) and lingual (L) The lingual fractures stand foremost in implication of the bite whereas the others stand out in the production of extreme facial deformities The ZO fractures may also result in double vision due to distortion of ocular muscle balance

From the standpoint of treatment the lingual fractures of the maxilla are best managed by intermaxillary or interdental wiring using the unaffected mandible as the splint Where the alveoli are not fractured but a separation of the maxillae exists rubber band elastic traction will suffice to replace the maxillae (Fig 373) In the NA type of fracture two separate factors must be considered The nasal bones must be restored to their normal position and contour and the maxillae proper must be reposed so as to insure proper tooth alignment with the mandible The latter may be controlled by simple interdental wiring and external bandage thus wedging the maxillae between the mandible and the base of the skull in occlusal position This type of fracture if bilateral may mean a complete separation of both maxillae from the base of the skull to which Erich refers as the pyramidal fracture In this type of injury the maxillae may be displaced upward and backward or downward (Fig 374) In the former instance the patient will suffer with a so-called open bite Roentgenograms in this type of fracture will show a separation displacement between the glabella and the frontal bones If the fracture displacement of the maxillae is allowed to heal uncorrected it is extremely difficult if not impossible ever to restore the bite with complete satisfaction

In the reduction of maxillary fractures by interdental wiring the hooked arched bar is preferable to any other form of intra oral appliance These bars should be placed both

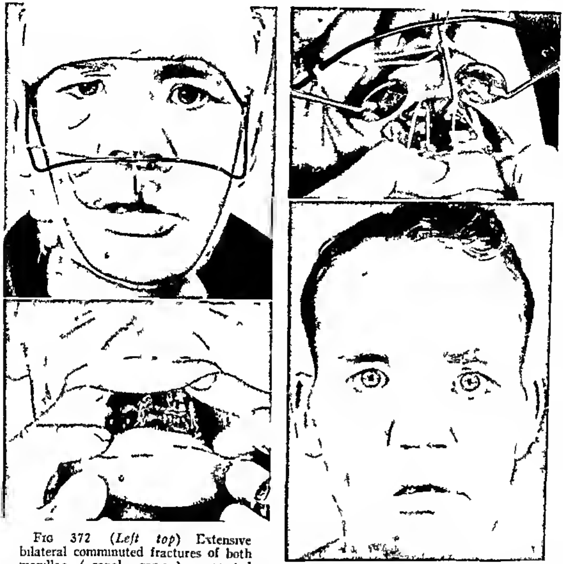

Fig 372 (*Left top*) Extensive bilateral comminuted fractures of both maxillae (zonal region) associated with basal skull fracture and healed compound avulsion of middle third of face consequent upon a propeller injury A type of external appliance for stabilization of the maxillae is shown This could not be applied for 3 weeks because of gravity of patient s condition Hence the recession of the middle third (zonal) of the face (*Left bottom*) Type of intra oral splinting in maxillary fractures after repositioning to maximum extent (*Right bottom*) Gross facial dystocia the unavoidable consequence of late treatment due to skull fracture and rhinorrhea Reconstruction of delayed cases is very difficult With the advent of biochemical agents such as penicillin delays in treatment can be avoided even in the presence of skull fracture

upon the affected maxillae and the teeth of the lower jaw They are then connected by rubber bands which usually takes care of the occlusal factor in the treatment If the maxillae are displaced backward they must be pulled anteriorly into position and this may be accomplished by attaching a separate rubber band to the upper arched

bar which is then secured externally to a metal rod incorporated in a plaster head cast (Fig 372) Where the maxillae are displaced upward and backward they must be pulled into position by attaching the strong rubber band to a longer metal rod projecting beneath the chin or to an external horseshoe shaped rod incorporated in a plaster of paris headgear, running from behind one mastoid around in front of the chin to the region behind the opposite mastoid Where it is not feasible to use the metal rod in downward displacements of the maxillae the so-called Lederspiel method of attaching wires to an upper arched bar in the region of the second premolar tooth and passing them out through

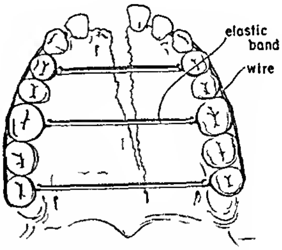

Fig 373 A manner of splinting the fractured and separated palate (Ivy Curtis)

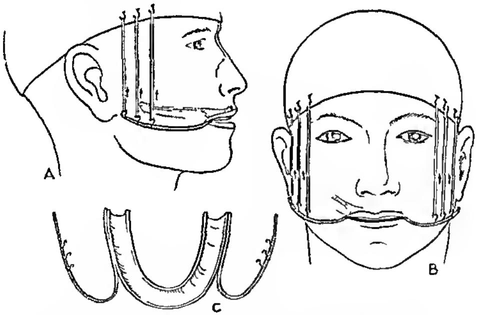

Fig 374 The reversed Kingsley splint The appliance for the teeth may be a dental tray made of acrylic or a preformed appliance to which side bars are soldered

the cheeks and then anchoring them to metal rods projecting radially from the head cap is a satisfactory method of reduction (Fig 375) Care must be exercised in projecting the wire through the cheek to the outside so its angle of incidence to the skin is not too obtuse or too acute In that case it will cut the cheek when attached to the rod projecting from the head cap

Maxillary fractures are not infrequently associated with skull fracture and involvement of the cribriform In such instances leakage of cerebrospinal fluid via the nose

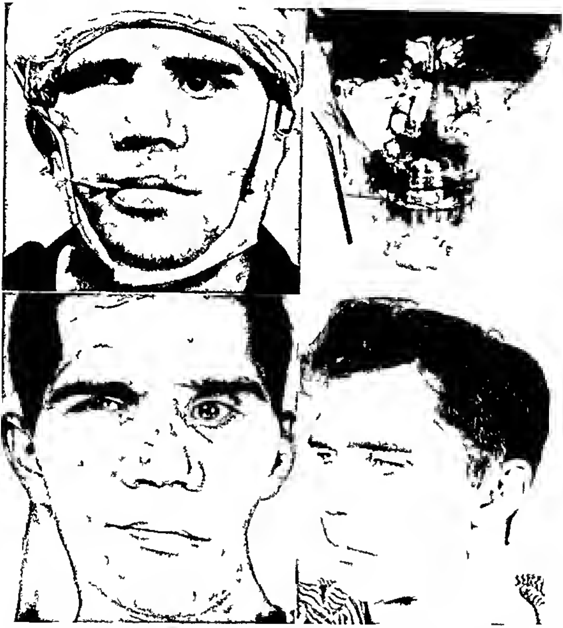

FIG 375A (*Top left*) Type of extemporaneous appliance in complex fractures of the facial bones (see roentgenograms) (*Top right*) Roentgenogram showing extensive loss of left mandible with fracture of right ramus bilateral maxillary fractures and the right malar zygomatic compound (*Bottom left*) Facial dystocia after stabilization of fractured jaws Note small pit in the right cheek the remains of wire shown above Also observe pronounced concavity of left lower jaw due to extensive bony void (*Bottom right*) Contour of left jaw after subtotal iliac bone graft of mandible (see Fig 375B) and reconstruction of left orbit by cartilage

will be observed and should be sufficient warning that general treatment of the patient and the skull fracture must be instituted before any attempt is made to reduce the fractures of the facial bones Only after a lapse of from ten days to two

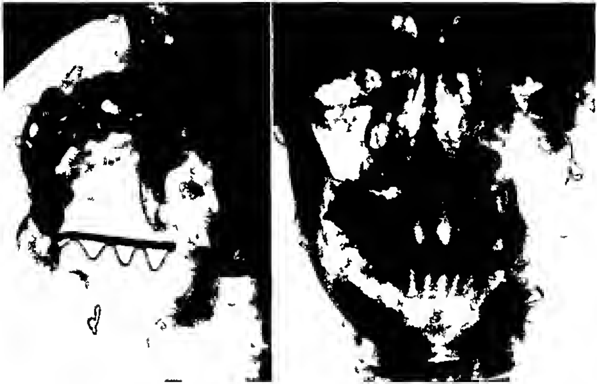

FIG 375B (*Left*) Roentgenogram of iliac bone graft of left mandible 7 months postoperative Note pronounced convexity of iliac graft (*Right*) Roentgenogram of bone graft of left mandible with interdental appliance in place associated with extension bar and undulating wire contrivance acting as a carrier for stent mold insinuated into buccal sulcus along the cheek

weeks (in certain cases even a lapse of three weeks) can one safely proceed with management of the fractures of the facial bones Obviously, where extensive soft tissue lacerations exist these should be repaired as soon as the general condition of the patient permits With the advent of chemotherapy the delay of from 10 to 14 days (ordinarily practical for fear of inducing a meningitis in these cases) may be shortened or even disregarded if the general condition of the patient is not too serious

All other items of pertinent management of maxillary fractures as well as theoretical and technical considerations are the same as applied to fractures of the mandible

Fractures of the malarzygomatic compound and the nasal bones will be found in the respective chapters dealing with the orbit and the nose

Other derangements of the maxillae are either so rare or of essentially orthodontic interest that they will not be considered here

General These may be congenital or acquired The congenital type may be improved by cartilage or bone inlays calculated to augment the facial form

The acquired general derangements may be the result of accident surgery or neoplasm The accidental type sometimes referred to as horse face is the result of severely comminuted fracture displacement of both maxillae The treatment is similar to the congenital type but more difficult and involved This is due to the coexistent involvement of the bite and other iotraoral complications such as oro antral fistulae (see Fig *372 bottom right* also Chap 34 Lips and Oral Cavity)

The surgically committed general de rangements are most frequently the result of ill advised or inexpert operations on the cleft palate This is particularly true where the premaxilla has been removed In such cases the entire middle third of the face becomes deformed with the lapse of time The satisfactory remedying of this condi tion is still an unsolved problem (see Chap 30 Face)

Excesses

True tissue excesses of the maxillae are rare with the exception of bony spurs which are usually found on the lateral walls of the maxillae just above the alveolus and necessi tate nothing more than submucoperiosteal removal with closure of the mucoperios teum Perforation into the antrum in the removal of spurs with a wide base is not uncommon and need occasion no anxiety if contamination is avoided and closure of the mucoperiosteum is airtight A soft diet should be given for 5 days

False tissue excesses are for the most part neoplasms of the maxillary bones or lining of the antrum whose eradication and method of treatment is entirely dependent upon whether they are benign or malignant This subject is adequately treated in books on otorhinology as well as general surgical texts The formative results of such ex cision of the maxilla are of particular in terest to the plastic surgeon The manage ment of such end results is basically the same as that discussed under tissue voids of the maxilla

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34

Lips and Oral Cavity (Cheil-oroplasty)

LIPS (CHEILOPLASTY)

The opinion is frequently expressed that the ear is the most difficult of plastic problems This is only true in a prosthetic sense From the standpoint of kinematic reconstruction, the lip, even more so than the eyelid, remains the supreme challenge to the plastic surgeon It is a subtle, mobile, ever changing appendage constantly full of expression The muscles of the face, innervated by cranial nerve VII (facial), in one way or another constantly affect the expression and the integrity of the lips The mouth like the hub of a wheel acts as the focus of expression

Voids

Total The reconstruction of a total loss of a lip implies three basic requirements the lining of the lip, muscle content and skin covering The second has not thus far been satisfactorily accomplished, wherefore most of the total reconstructions are based upon the prosthetic plan of providing a lining with its vermilion and the skin covering This gives a fairly satisfactory mimicry of the normal appendage The lining of the lip is undoubtedly even more important from the standpoint of eventual integrity than the skin covering

The numberless operations recommended for the total reconstruction of the lips may be divided into three classes

The first class is based upon the medial shifting or rotation of cheek tissues en bloc over the teeth without separate dissection of the lining mucosa or the overlying skin These are the methods of Denonvilliers, Lisfranc Lexer, Dieffenbach, Nelaton Ombrédanne and others Although from an anatomic standpoint some of these operations are adequate and most of them seem to fulfill the requirements, from a functional standpoint many of them are destructive in that they impose a functional and anatomic burden upon the cheek which it cannot afford

Contemporary plastic surgeons have based the total reconstruction of lips upon separate dissection of the intra oral mucosa, shifting or rotating it in suchwise that it covers the teeth rawside out and then covering this lining by flaps of skin and subcutaneous tissue mobilized usually from the paranasal region for the upper lip and from the chin or the submental region for the lower lip Outstanding in this group is the operation of Neal Owens for the reconstruction of the lower lip (Fig 376) The second class of procedures is that based upon turning over and across the teeth skin flaps from the neighboring cheek region as lining for the new lip and then rotating collateral or adjacent skin flaps over the former as a covering for the new lip Outstanding among the latter class of procedures are those of Ferris Smith and G Pierce (Figs 377 and 378) The latter type of procedures are multistage as a rule in that later a vermilion has to be provided for the lip This may be accomplished by free transplantation of intraoral mucosa to the free edge of the lip, by advancing the residual vermilion of the lip outward by the hammock transposition of the vermilion from the good lip to the new by the method of Schulten, or, as recommended by Blair and Brown tattooing of the new lip

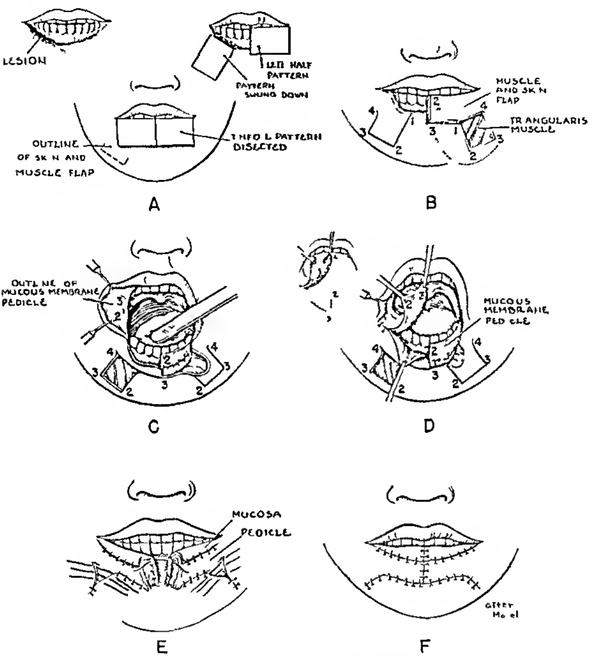


Fig 376 A procedure for the reconstruction of the lower lip (Neal Owens)

A modification of the third class of procedures is that of Cole (Fig 379) It is based upon the use of the so called stirrup flap swung down from the hairy portion of the scalp and pedicled above the ears The peduncles are returned to the head when healing of the new lip is completed The latter procedure was popularized by Lexer and to a large degree, is still subscribed to on the European continent because its donor site furnishes a beard in the male which is a social advantage in some countries

Where absence of the lower lip is associated with loss of the mandibular symphysis, the procedure of Kazanjian may be

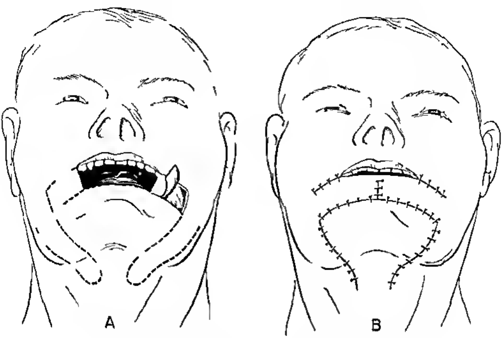


FIG 377 A method for the reconstruction of the lower lip (Ferris Smith) The short horizontal cheek flaps form the lining of the lip

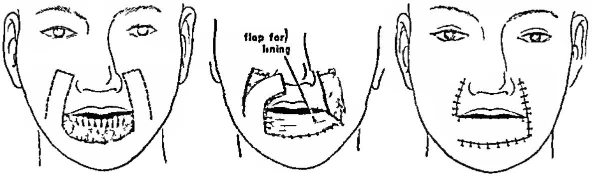
used as a basis for reconstruction (Fig 380) It provides an adequate tissue bed for subsequent bone grafting which it is impossible to establish by a free graft lined flap and improbable by attempting to line it with mucosa

The third class of procedures is based upon importation of tissues in the form of a tube (Fig 381) This is unavoidable where the quantity and the quality of adjacent tissue is inadequate for shifting of flaps After the tube has been properly spanned across the lip defect and has attained circulatory integrity and complete organization it is shaped by secondary revision through excision of its fatty content After the lapse of two or three months its free border may be tattooed to mimic the vermilion or a mucosal graft may be applied to its border

Partial Partial losses may be regional full thickness or superficial losses involving the vermilion or the skin The regional losses may be divided into those of the lip proper or the commissures The partial losses of the lip proper may usually be restored by the so called Estlander Abee operation [Poul Fogh Andersen recently pointed out that this operation actually should be credited to Professor S Stein a Danish surgeon who recorded it in 1848 as an original procedure (Figs 382 384)] More extensive acute or surgical voids particularly of the lower lip may be efficiently closed by the procedure of C Bernard (Fig 385) Neal Owens (Fig 376) or some of the older procedures of Nelaton Ombredanne Lexer Sedillot and others

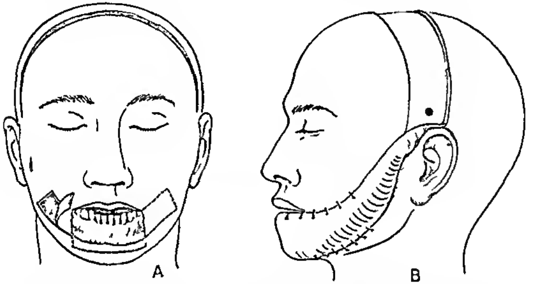
The commissural losses of the lips are best restored by the creation of a new angle of the mouth These may be reconstructed by the use and knowing repositioning of tissues in the immediate vicinity (Fig 386) by the method of Serre or Erichsen or the method shown in Figure 387

Losses of the vermilion of the skin will be discussed presently under Derangements



A B C

FIG 378 A method for the reconstruction of the lower lip (George Pierce)



A B

FIG 379 A method for total reconstruction of the lower lip via the use of a cephalic hammock flap (Cole) This method finds its special virtue where a full beard is required

DERANGEMENTS

Segmental derangements may be either congenital or acquired The outstanding congenital derangement, of course, is the cleft lip, or so-called "harelip" It is listed under derangements because, as a rule there is sufficient tissue present for the reconstruction of the apparently absent lip The acquired derangements of the lips are usually the result of direct injury, such as burns resulting in loss of vermilion or skin or both Other acquired conditions such as ectropion, entropion and microstomia sometimes referred to as "buttonhole mouth" are late cicatricial developments They may, of course, be congenital in origin

CLEFT LIPS may be partial complete, unilateral, bilateral simple or complex, the complex classification implies coexistent deformity of the nose premaxilla, alveolus or palate

It is important for the student to be impressed by the fact that the condition known as cleft lip is initially a pediatric

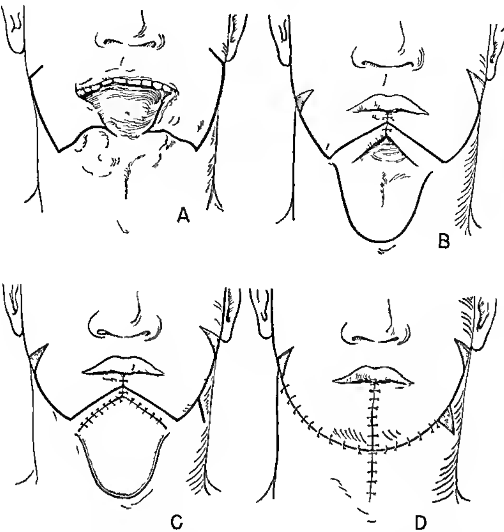


Fig 380 A method for the reconstruction of the lower lip and chin (Kazanjian)

rather than a surgical problem Although it is not impossible to do an immediate repair of a cleft lip following birth it is not to be recommended as an intelligent procedure The shock of being born is enough to experience without adding surgical insult to the physiologic ordeal

Only after the child has attained more or less normal weight and is in good general condition does the repair of a cleft lip become a surgical proposition Experience indicates that the optimum time for repair is between the second and the fourth months

The next point of practical value to the student is that surgical closure of a cleft lip is not a simple exercise in suturing but constitutes a major reconstruction of the nasolabial area and is therefore an extensive rhinocheiloplasty

Historically the closure of a cleft lip never attained the dignity of reconstruction until Mirault in 1844 put forth the idea of flap repair Blair by reducing Mirault's operation to geometric accuracy established a functional perspective apropos the problem The Blair modification of the

FIG. 381. (*Left*) Total loss of the lower lip, with partial loss of the upper lip without benefit of adequate collateral tissues for reconstruction In such cases, tissues extraneous to the face must be imported. (*Right*) Upper lip reconstructed from local tissues and cheek lining. Inferior edge of tube still needs to be laid out to complete reconstruction of lip.

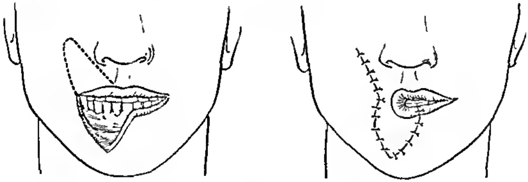


FIG. 382. The Stein-Estlander operation for reconstruction of the lower lip.

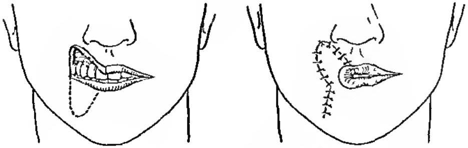


FIG. 383. The Stein-Abbé operation for reconstruction of the upper lip (see Fig. 384).

FIG 384 *(Left)* Typical facies in the ill advised harelip operation where the pre max lla has been removed Profile view *(Center)* Same pat ent Repair of upper l p by Stein Abbe procedure 7 days postoperative *(Right)* Postoperative profile Note well shaped vermilion of upper lip (no prosthesis) Premaxilla substituted by clavicular bone graft

Mirault procedure still remained basically a cheiloplasty

During World War II Axhausen pub lished his procedure on the reconstruction of the cleft lip with attention extended to the rhinoplastic aspect particularly the nasal floor (Fig 388) This evolution in the development of cleft lip surgery brings out the important fact that the condition is basically a rhinocheiloplastic problem Recently J Barrett Brown advanced the Mirault Blair operation toward even more gratifying formative ends with the publica tion of his Simplified Design for Repair of Single Cleft Lips which may be the foundation for a truly satisfactory esthetic reconstruction of the cleft lip an important final step in the evolution of cleft lip sur gery (Fig 389)

In 1948 LeMesurier presented a simpli fied method inspired by the old Hagedorn procedure which bodes to resolve the prob lem of controlled formative restoration to a better degree than other methods (Fig 390) Geometrically it is a simpler method than that of Brown and where applicable yields controlled height thickness and mo bility of lip unequaled by most other pro cedures

Unless the original repair of a cleft lip provides for adequate esthetic as well as functional (kinesthetic) reconstruction a life long stigma remains as embarrassing to the grown patient as the original defect is incapacitating to the child Such evi dences of inadequate kinematic reconstruc tion are vermilion asymmetry notching of the lip deformity of the ala flatness of the cheek scarring diastasis of the orbicularis oris deviation of the nasal tip and colu mella deformity of the floor of the nose and others (Fig 391) These must be cor rected in later life lest they lead to psycho logical implications

A large percentage of cleft lips are com plicated by a deformity of the premaxilla the alveolus and/or a cleft palate The first problem is best resolved in most cases by relying upon an adequately repaired cleft lip to act as the molding force for the de

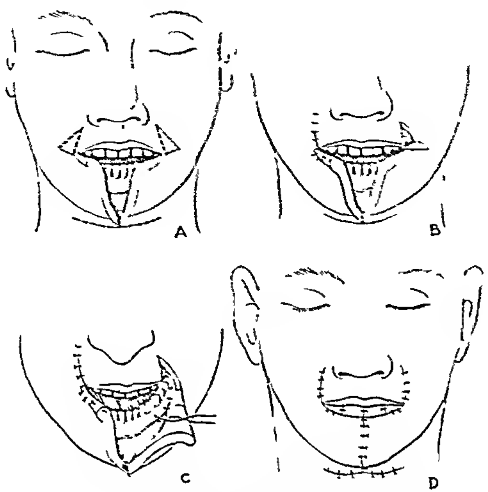


FIG 385 Procedure for immediate closure of lower lip following extensive surgical resection (C Bernard)

formed alveolus Forcible closure of defects in the latter is not good procedure Under no conditions should the premaxilla be removed In any case, undue tampering will lead to the grossest facial deformities almost impossible to correct Only after the reconstructed lip has more or less molded the alveolus into normal contour and position, usually a matter of three or four months, should the continuity of the latter be re-established by proper mobilization of mucoperiosteal flaps The closure of the palate is a separate issue and is discussed in this chapter under oroplasties

Bilateral clefts of the lip may be one of the most difficult problems in reconstruction In these cases because of the complete absence of antagonistic muscle action to the development of the vomer the premaxilla may protrude to an unusual degree This coincident with the maldevelopment of the columella and the nose may result in a defect which from the standpoint of complete reconstruction often necessitates extensive mobilization of all the tissues of the lip nose and both cheeks The procedure of Victor Veau still remains a reliable basis of approach to the correction of this condition In very difficult cases, Ivy recommends doing one cleft at a time thus converting the double cleft lip into a single one In most cases final closure of the lip is adequate in repositioning of the protruding maxilla Where the latter projects

to an unreasonable degree some surgeons recommend sectioning of the vomer behind the premaxilla or removing a wedge of bone and cartilage, thus allowing for forceful re positioning of the premaxillary stump Where this is done it must be performed with exceeding care so as to avoid over displacement of the premaxilla inwardly

In bilateral cleft lips with prominent or protruding premaxilla a one stage closure is indicated In the simple types the method of Meyer may be used to advantage This consists in the mobilization and the eleva tion of the soft tissues lying upon the pre maxilla so as to be able to advance them superiorly to add to the columella and also aid in the remodelling of the nose The space left by the elevation of the soft tis sues is covered by two vermilion flaps coming one each from the lip segments of the clefts, which are then sutured in the midline under the elevated filtrum These when covered by the soft tissues of the lip segments moved medialward to meet each other result in continuity of the inferior rim of the lip and a triangular defect be tween the latter and the nose which is then covered by the repositioning of the origi nally elevated soft tissues from the project ing premaxilla A similar method has re cently been recommended by Schultz who seems to have arrived independently at a procedure basically not unlike that of Meyer (Fig 392) As with the develop ment of operations for single harelip the procedures of Meyer and Schultz as well as others are not entirely adequate to cope with the case where there is considerable nasal distortion In other words these op erations are basically cheiloplasties with

FIG 386 (*Left*) Gross distortion of the mouth following emergency repair of gunshot wound of left jaw Retraction of soft tissues due to gross loss of left mandible (*Right*) Condition after single stage recon struction of the soft tissues Note formative improvement of left side of face even prior to bone graft

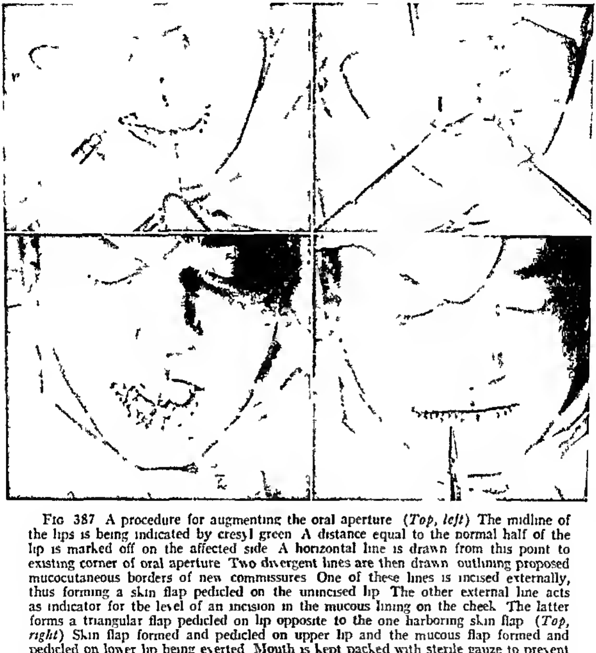


FIG 387 A procedure for augmenting the oral aperture (*Top, left*) The midline of the lips is being indicated by cresyl green A distance equal to the normal half of the lip is marked off on the affected side A horizontal line is drawn from this point to existing corner of oral aperture Two divergent lines are then drawn outlining proposed mucocutaneous borders of new commissures One of these lines is incised externally, thus forming a skin flap pedicled on the unincised lip The other external line acts as indicator for the level of an incision in the mucous lining on the cheek The latter forms a triangular flap pedicled on lip opposite to the one harboring skin flap (*Top, right*) Skin flap formed and pedicled on upper lip and the mucous flap formed and pedicled on lower lip being everted Mouth is kept packed with sterile gauze to prevent contamination of the operative area (*Bottom, left*) The flaps are shown sutured into position Note extent of lower vermilion flap whose origin is the lining of the cheek The mucous flap always should be pedicled on the lip which by comparison possesses the widest vermilion border (*Bottom, right*) Operation completed Note equal extent and balance of the lips Also note balanced position of the commissures

only secondary consideration for the nasal problems which might be present In such instances the nasal dystocia must then be corrected at a subsequent operation

The ability, the experience and the imagination of the operator have so much to do with the end results obtained in any large series of cases (no matter what method of reconstruction is followed) that secondary corrections of reconstructed cleft lips are

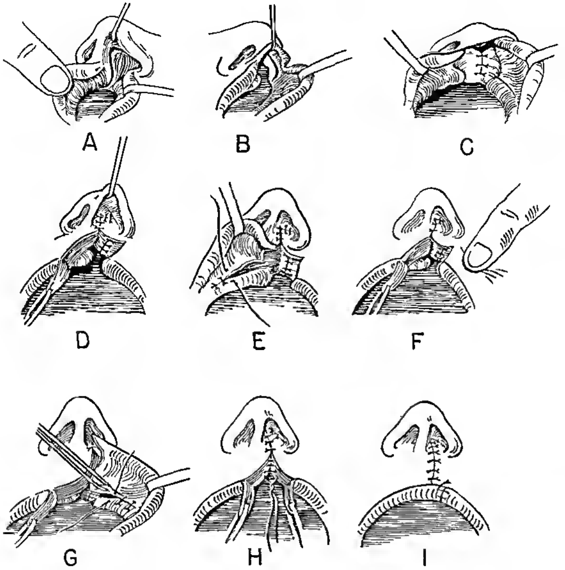
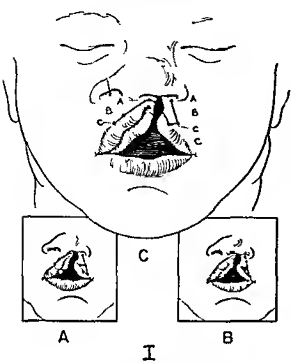
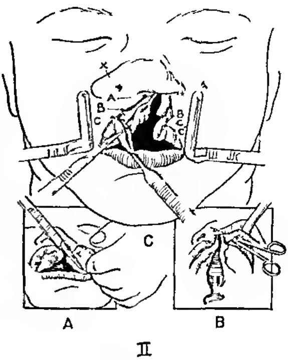


Fig 388 A method of repairing a unilateral cleft lip (Hans May after Axhausen) (A) Formation of a median turn over flap (B) Formation of a lateral turn-over flap (C) Turn over flaps sutured together to form floor of nostril (D) After incising under affected ala and suturing latter to the columella septum is undermined so it can be displaced medially as shown thus creating a lateral and median vermilion flap (E) Formation of median vermilion flap and reorientation of septum (F) Formation of the lateral vermilion border flap (G) Median advancement of the lip lateral to the cleft (H) Layer to layer approximation of lip tissues (I) Step closure of vermilion to obviate notching of border This is accomplished by making the median vermilion flap somewhat longer than its lateral mate

not uncommon These residual deformities of the repaired cleft lip may be divided into two types those which are the results of cruel repair eventuating in extensive scarring and the results of wrong repair eventuating in deformity The former are usually resolved more or less easily by complete excision of the scar tissue and simple





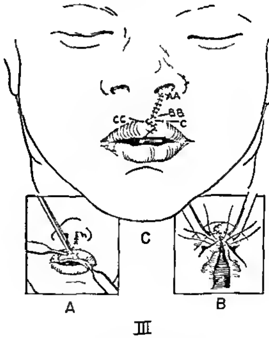


FIG 389 Brown McDowell's simplified design for repair of single cleft lips (*Top left*) A is marked at the junction of the skin and vermilion at the level of the base of the columella X is in the same relation to the columella on the sound side A′ bears the same relation to the ala on the cleft side that X bears to the ala on the normal side C is on the mucocutaneous junction at the point where the vermilion first begins to thin out C′ is on the mucocutaneous junction the same distance from A′ that C is from A A′ is brought over to A and C′ to C after excision of the edges of the cleft (*Top, right*) The lightly incised lines A B C and A′ B′ C′ are cut completely through the lip with a stab blade with care to keep knife exactly perpendicular to lip All angles should be completely open The vermilion is inspected and any attached skin removed with a stab blade The rectangular flap freed from A′ B′ C′ must be loose enough to be rotated up 180 degrees into nostril floor Dotted lines indicate area undermined (*Bottom*) C and C′ are united and the vermilion flaps are interdigitated in a zig zag fashion fitting them so that they lie naturally together without any pull or stretching Suturing is then continued on around the vermilion border and up the inside to the fornix The little flap in the nostril is trimmed to fit with the one from the opposite side, and they are sutured together to form the floor A few key mattress sutures are placed through the ala to unite the lining and covering (which were separated during the undermining) (Brown and McDowell Surg Gynec & Obst 80 12 26)

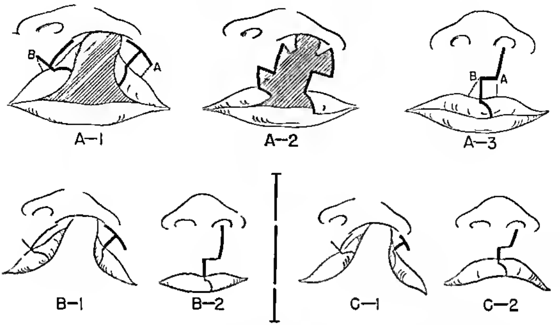


FIG 390 LeMesurier operation for unilateral cleft lip (A 1) Incisions outlining flaps for new lip Short broken lines at A and B are determinants of height of cupid s bow Horizontal of T incision in lateral side of cleft and long arm of V incision in medial side of cleft determine height of upper half of new lip The vertical arm of T and the short arm of V determine height of lower half of new lip (A 2) Incised segments of cleft lip opened and rotated into position for approximation (A 3) Repair completed Note geometric simplicity of method and exactitudes of relationship of original incisions to height of lip and form of cupid s bow (B 1 and B 2) Effect of exaggeration of size and position of incisions in sides of cleft upon height of lip (C 1 and C 2) Consequences of cutting the lip flaps too small and too high In this case it results in a short lip (LeMesurier J Plast & Reconstruct Surg 4 1)

revised closure of the lip provided that the amount of scar tissue does not eventuate in an absolute tissue void In such instances tissue must be brought in to compensate the upper lip for the loss due to scarring and fibrosis This may be accomplished by some modification of the Stein Estlander Abbe procedure (Figs 382 384) The lip which is completely deformed as a result of wrong procedure usually is not amenable to adequate reconstruction It is unequivocally true where the premaxilla has been completely sacrificed The reconstruction of this type of case is either a matter of repeated extensive operation or must be resolved by some type of prosthesis The most common associated deformities of a repaired cleft lip are those involving the nose Their management is discussed in the chapter on rhinoplasties

ACQUIRED DERANGEMENTS The most common traumatic derangements of the lip are those due to poor original repair of lacerations perforations and burn scarring and distortion In distortion the corners of the mouth may suffer foremost Cicatricial displacement of the oral commissure may be corrected by a Z plasty or some modification thereof (Fig 393) These types of derangements usually do not involve the full thickness of the lip but more commonly affect only the skin covering and subcutaneous tissue and occasionally the muscle itself The problem here is one essentially of new covering tissue with resuturing of the orbicularis oris muscle

FIG 391 (*Top, left*) A common postoperative consequence of inadequate reconstruction of harelip Note notching of upper lip, pitting under right nostril due to diastasis of orbicular oris and inequality in tip of nose due to incomplete nasal repair (*Top, right*) Ventral view of nose to show inequality of nostrils, fibrous contracture within right nostril and asymmetry of lip (*Bottom, left*) Showing improvement in nose and lip following secondary repair (*Bottom, right*) Two years after secondary repair of nasal dystocia and upper lip

The former may occasionally be accomplished by mobilizing collateral skin flaps and shifting them over the defect (Fig 394) Often tissue must be brought in from greater distances

The nicest and most practical method of

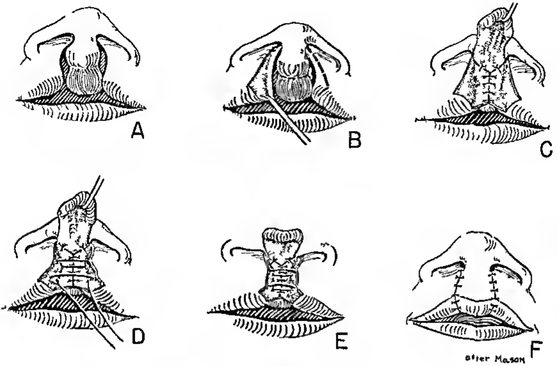


Fig 392 A procedure for the repair of bilateral cleft lip (Schultz)

closing tissue defects following excision of large deep lip scars is to rotate downward a paranasal flap shaped in the form of a *triangle whose apex reaches at times to* the inner canthus (Fig 395) These rotational flaps may be bilateral thus afford ing sufficient tissue for over all coverage of the entire lip The operation is usually a two stage procedure the second stage consisting of esthetic revision of the peduncle of the flap in the vicinity of the corner of the mouth Because these cheek flaps can be fashioned so as to bring considerable subcutaneous tissue with them they almost invariably result in a nice full lip This fullness though attainable by the importation of tissue in the form of small tubes leads in the latter instance to several secondary operations and seldom results in as good a color match of the upper lip

Traumatic full thickness derangements of the upper lip are not rare and are almost invariably the result of poor original repair which resulted in excessive scarring In this type of derangement the excision of the *scar tissue results in an extensive void of* the upper lip whose reconstruction may be impossible without bringing in tissue from a distance It is in cases of this type where the Stein Estlander Abbe procedure finds one of its outstanding applications (Fig 383)

Ectropion of the upper lip may be due to a congenitally short lip or the result of the influence of the paranasal musculature upon the excursions of the lip The former may be corrected by an Y plasty (Fig 396) The correction of the latter as recommended by John Staige Davis is best accomplished by transection of the fine paranasal muscles, thus freeing the orbicularis oris of its paranasal attachments and allowing gravity to pull the lip down

Entropion of the upper lip is usually of traumatic origin and is associated with loss of the mucous lining of the upper lip and

sometimes the alveolus The correction of this condition resides in the complete excision of the scar tissue under the lip, freeing of the latter to an extent consistent with the remainder of the labial sulcus and free grafting of the raw area with a split skin graft in accordance with the Waldron Esser technic

In connection with ectropion of the lower lip, C H Firestone has suggested recently an operation based on the same principles recommended by John Staige Davis for the upper lip sectioning of the fibers of the depressor labii inferioris muscle which is done subcutaneously after undermining of the skin The division of this muscle obviously helps in the correction of the eversion but must be attended by excision of a certain amount of soft tissue of the lip consisting mostly of the labial glands, in order to reduce the thickness of the appendage which is a concomitant of the eversion

Microstomia or 'buttonhole' mouth may be congenital or traumatic in origin The congenital type of small mouth may be corrected by appropriate slitting of the two commissures to the desired extent, undermining of the mucosal lining of the lips and advancing the latter to meet the skin edges outwardly In selected cases the author's web splitting procedure may be used, particularly where less acute angles are desired than result from simple incision of the commissures (Fig 387)

The correction of the traumatic types depends upon whether the entire lip structure is involved or only the commissures In the former instance tissue may have to be imported in the form of tube pedicles to supply substance to the lips and the latter then tattooed or free grafted with vermilion taken from the inside of the mouth If only the commissures of the mouth are affected the scar tissue is excised, and a triangular flap of mucous lining of the cheek is advanced outward to be sutured into the new corners of the mouth If healing of the injury has resulted in partial eversion

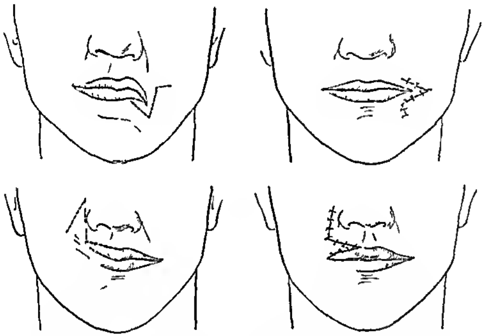


FIG 393 (*Top*) Z plasty of oral commissure when displaced downward (*Bottom*) Z plasty of oral commissure when displaced upward

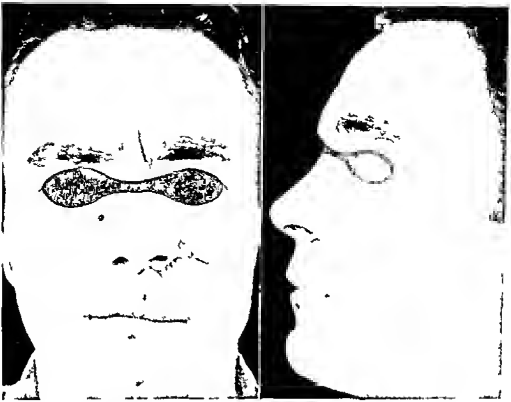


Fig 394 Repair of through and through lip void by sliding cheek flap Short divergent arm of closure in profile photograph the result of excision of triangles to allow for shifting of flap nasalward

of the lining of the mouth a web splitting operation may be done as indicated in Figure 387

General Over all derangements of the lips if congenital may be repaired by full *thickness sectioning of the appendages* at predetermined points geometrically planned with rearrangement of lip levels The basic approaches are not unlike those for complete hare lip operations

In traumatic general derangements there is always the factor of scar tissue After excision of the latter extensive voids result which may then be dealt with in accordance with procedures discussed under Partial Voids above

Excesses

True excesses of the lips consist of double lip macrostomia and macrocheilia The double lip may be corrected by an appropriate incision of the mucosa with undermining and resection of the hypertrophied glands Closure of the mucosa should be done in the manner of a Z plasty to avoid *fiddlestring tension which may interfere* with expression Macrocheilia more often affecting the lower than the upper lip can be corrected by an appropriate modification of Joseph s operation for hypertrophy of the lower lip (Fig 397) This consists in the excision of a triangular wedge from the center of the lip through its entire thickness and two collateral triangular excisions of the lining of the lip with partial resection of the orbicularis resulting in an inverted T closure

Macrostomia or the true large mouth must not be confused with a unilateral or bilateral cleft mouth The latter may be

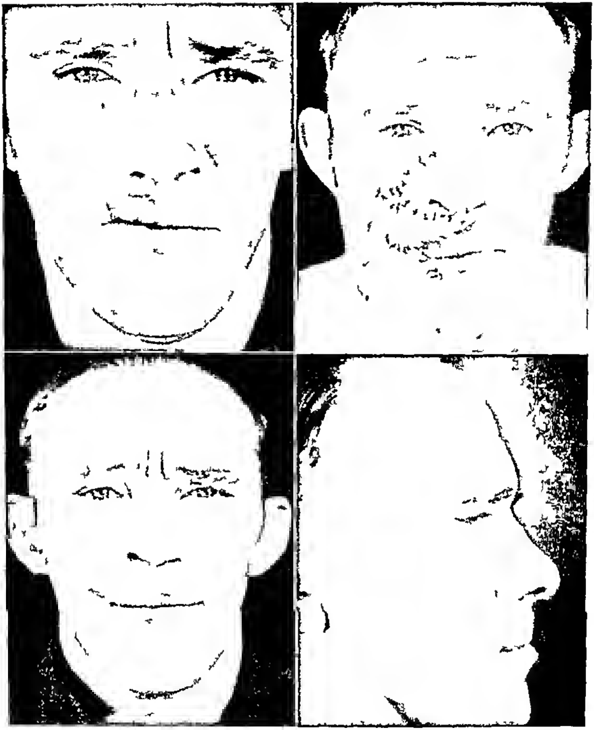


FIG 395 An operation for derangement of upper lip (*Top left*) Preoperative scarred upper lip with twisted nose (*Top right*) A method of correcting derangement by a rotating French flap from the paranasal region Note temporary cheilorrhaphy instituted by passing stainless steel wire mattress suture through both lips entering and exiting through lower lip where it is tied over buttons This type of splinting is simple and can be maintained for a period of from 10 days to two weeks which usually is adequate for this type of repair (*Bottom left*) Reconstruction one month postoperative Note slight rolling of flap in region of right commissure an unavoidable detail in a patient with comparatively large cheeks This must be corrected by a secondary revision (*Bottom right*) Profile view of bottom left

corrected by incisions into the lips of the cleft and layer to layer approximation beginning with the mucosa and ending with the skin Macrostomia, on the other hand, necessitates geometric excision of through and through sections of both lips This results in triangular surgical clefts usually two in the upper lip (one in each commissure) and one in the lower midline Reduction in the thickness of the lips is then accomplished by collateral triangular excisions of the vermilion and the underlying glandular tissues with layer to layer repair An important detail in the closure of such lip resections is that a small Z be incorporated in the borders of the vermilion so as to avoid postoperative distortion always

A vast amount of clinical experience which has accumulated in the past decade points to the advisability of extirpating the cervical glands before resection of the lip carcinoma or at the time of its ablation This obviates delay in curbing of the metastatic progress of the disease while waiting for healing of the cheilectomy Preoperative x ray therapy to the neck is no substitute for radical gland resection where this is possible

ORAL CAVITY (OROPLASTY)

Voids

Total voids of the oral cavity though not unknown in fetuses and occasionally

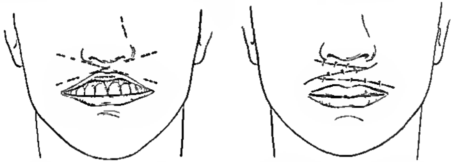


Fig 396 Correction of ectropion of upper lip by 'X' plasty (Teale)

to be feared in a suture line running at right angles across the line of the vermilion

False excesses of the lips consist of cysts arteriovenous aneurysms nevi keloids and neoplasms—foremost among them carcinoma The treatment of carcinoma depends to a large degree upon the extent and the duration of the disease as well as possible involvement of the cervical lymph glands In the early stages of the involvement of the vermilion the use of radium or wedge shaped excision with step closure of the vermilion border may be adequate (Fig 21A) Where carcinoma has obviously involved the entire thickness of the lip and there is reason to believe that the cervical glands have become involved extensive extirpation of the latter is indicated (Fig 398)

seen in warfare are exceedingly rare In the former they are inconsistent with life and in the latter not amenable to adequate reconstruction because of the gross involvement of the facial musculature or the neck

Partial voids of the oral cavity are comparatively common The outstanding congenital partial void is the cleft palate whereas the not uncommon traumatic void is the loss of the lining of the oral cavity or of the tongue Where the partial traumatic loss is due to a gunshot wound it may involve the palate the tongue the lining of the cheeks and other important subdivisions of the oral cavity

Cleft Palate (Uranoplasty) Clefts of the palate may be unilateral or bilateral but never median, except insofar as they

Fig 397 (*Left, top and bottom*) Ectropion of lower lip (*Right, top and bottom*) Corrected ectropion of lower lip

Fig 398 (*Left*) Neoplasm of lower lip following single trauma, diagnosed by pathologist as carcinoma (*Right*) Same case, ulcerating carcinoma 5 months after injury There has been no recurrence 10 years after full thickness wedge resection

involve only, or extend into the soft palate, in which case they usually assume a median position In this respect clefts of the palate and clefts of the lip bear a relationship to each other A true median cleft of the lip never has been recorded In degree, there are four types clefts of the soft palate (partial or complete), partial clefts of the hard palate complete clefts of the hard palate (usually associated with unilateral cleft lip) and bilateral clefts Any combination of these four may be seen (Fig 399)

Probably for lack of proper perspective and appreciation of the extent and the perplexity of the palate defect, the older operations consisted of attempts at simple suturing of the two mucoperiosteal lips of the defect One of the oldest classical procedures of this type is that of Langenbeck It consists of a relaxing incision of the mucoperiosteum for a variable distance along the alveoli, undermining of the former and shifting of the mucoperiosteal flaps into the midline where, after rawing of their edges, the two are sutured together With clinical experience in this type of operation it soon became apparent that the procedure was only adequate for very selected cases It remains inadequate for two reasons first, because it is contrary to one of the basic principles of reconstruction (that tissues which are the keystone of a repair having to do with a cavity, must be lined) and, second the surgical pathology in cleft palate is far more complex than the obvious cleft Full appreciation of the extent of the defect establishes four main prerequisites of adequate reconstruction The first is re establishment of the continuity of the roof of the mouth the second is the reconstruction of the floor of the nasal cavities, the third is reconstruction of the size and the shape of the oropharynx, and last, but not least a movable, soft palate

At the turn of the century, Brophy, recognizing the fact that not only the palate itself but the maxillae were implicated in the cleft, resorted to forceful repositioning thereof in the hope that better results might be obtained Experience has shown that forceful repositioning of the maxillae only results in eventual irremediable deformity of the bite and sometimes the entire face Wolfe, later followed by Victor Veau of Paris began advocating the complete reconstruction of the various cavities entering

into the defect Veau's work and method, through somewhat more complicated than other procedures such as the Dieffenbach Warren operation still stands as the classical procedure in the over all reconstruction injury to the palatal and nasopharyngeal musculature This is accomplished by mobilizing the mucoperiosteum of the vomer to act as the floor of the nasal chamber and suturing of the mucoperiosteum of the palate

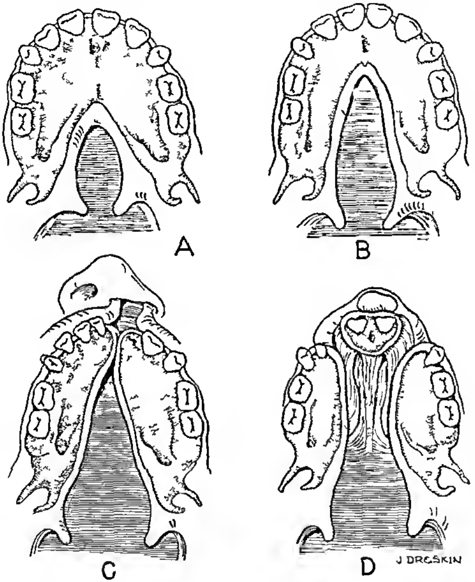


Fig 399 Types of cleft palate (A) Cleft of soft palate (B) Incomplete cleft of palate (C) Complete cleft of palate with unilateral cleft lip (D) Bilateral cleft palate

of the cleft palate (Fig 400) The operation is based upon the principle of adequate epithelial lining of both the nasal as well as oral cavities avoidance of all dead space between the two and obviating all possible thereto with adequate muscle approximation and minimal separation of the soft from the hard palate Notwithstanding the Veau procedure is not always applicable

Due to lack of proper development many

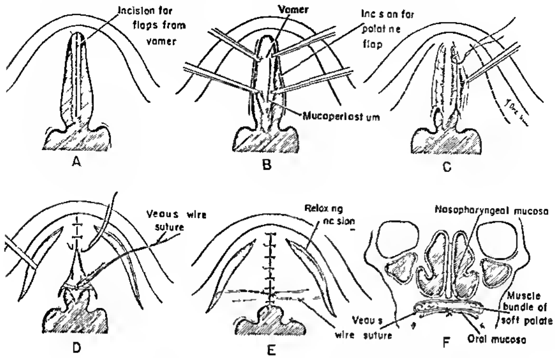


FIG 400 Veau s procedure for uranoplasty (graphic) The basic principle is the separation of the nasal from the oral cavity via mucoperiosteum of the vomer

cleft palates are too short to accomplish adequate nasopharyngeal closure The Veau procedure seems to be inadequate to meet this demand The need for adequate nasopharyngeal control of sound has given rise to many procedures whose purpose is the deliberate displacement of the soft tissues of the palate toward the nasopharynx Outstanding among the contemporary procedures are those of Dorrance, Brown and Burian In principle, they consist of the complete elevation of the mucoperiosteum of the palate and shifting of the horseshoe shaped flap toward the back of the pharynx In the Dorrance procedure this radical elevation includes severance of the greater palatine arteries and hence a necessity for delay of the flap Brown and Burian dissect the attachments of the greater palatine artery about the foramen and suture the free anterior edge of the flap to the mucoperiosteal fringe on the nasal aspect of the palate Closure of the cleft in the soft palate may follow later Burian of Prague routinely joins soft palate to a pharyngeal flap with admirable results

Because of the basic objection in these procedures to a large raw surface on the nasal aspect of the flap resulting often in considerable contracture of the latter, Baxter and Cardoso have emphasized the need for epithelization of the raw surface by means of a split skin graft This is accomplished by wrapping the split graft, raw surface outward about a stent compound which has been molded to the space created between the flap and the hard palate by the former s elevation The mucoperiosteum of the hard palate is then replaced over the mold for two or three weeks after which the mold is removed and a typical push back operation is carried out This addition to cleft palate surgery is a basic improvement on the conventional push back procedures (Fig 401)

Partial if not total failures in cleft palate surgery are not uncommon This applies particularly to residual perforations

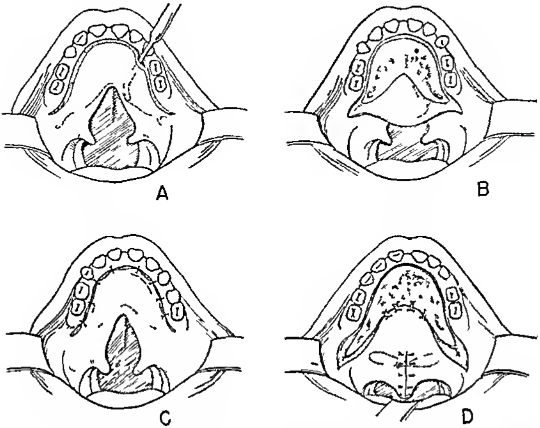


Fig 401 Principle of lining raw surface of palate flap in push back operation This aids in avoiding late postoperative contractures of repaired palate (See Burian s pharyngeal flap in text)

Fig 402 (*Left*) Common residual defects in cleft palate surgery small opening in the vicinity of the incisive foramen and minimal separation of the uvula (*Right*) Method of preventing patient from disturbing palatal repair with his tongue Two or three cross wires are placed to span dental arch and a cellophane or fiberglas pack is insinuated between the wires and the repair

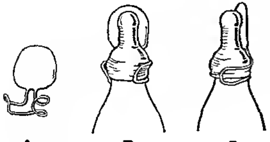


FIG 403 An obturator for use in feeding cleft palate cases (Albray)

remaining in the region of the incisive foramen, at the juncture of the hard and soft palates, and of the uvula Careful original repair accepted, one must often look into the habits of an individual to find the real reason for repeated failures This applies to adults as well as children Often the patient commits willful indiscretions, such as sticking his tongue into the repair until the latter gives way Precautions must be taken against such problems (Fig 402)

Where operation for cleft palate has to be delayed for any reason the question of adequate feeding of the infant becomes an important one Ordinarily the dropper or gavage method is adequate These are nevertheless beset with certain difficulties, hazards and risks To make the feeding of these infants easier, R A Albray, in cooperation with Lyndon A Peer, has devised an obturator made of lucitone, a plastic material 1 inch in width, 1¼ inches long, and $\frac{3}{16}$ of an inch thick, roughly oval shaped and slightly concave, which, by means of a stainless steel wire clasp, grips the neck of the bottle over the base of the rubber nipple (Fig 403) The size and the shape of the obturator is such that it fits almost any average infant s palatal defect This allows feeding via bottle without the difficulties and the complications usually attending it Because of the material which goes into its construction, the obturator is easily sterilized

In certain instances, in spite of retroposition of the palatal tissues by means of the Dorrance, Brown or Burian procedures, sufficient nasopharyngeal closure is not to be attained, and the patient continues to have the voice so characteristic of cleft palate cases In such instances the so called Wardill pharyngoplasty may be done for the promotion of velopharyngeal closure This is accomplished by advancing the posterior pharyngeal wall forward At the level of Passavant's ridge a transverse incision is made into the mucous membrane This should not be so deep as to go into the prevertebral fascia The mucous membrane is then undermined superiorly, including the *superior constrictor, as high up as is* possible and downward for approximately the same distance Adequate lateral elevation of the mucosa is then done on both sides, and the incision is closed in a vertical direction If the lateral elevation of the mucosa is adequate, that is, extending past a ridge caused by the salpingopharyngeus muscle, the folds of the latter are brought together in the midline Burian s flap is more dependable

No attempt has been made toward detailed discussion of any of the procedures cited for the repair of either the cleft lip or cleft palate (except insofar as the illustrations indicate the vital steps in the procedure), because the size of the text does not permit It is a subject to which volumes have been dedicated since the turn of the century * An outline of basic problems and procedures has been nevertheless thought necessary to indicate to the student the extent and ramifications of the field of general plastic surgery

TRAUMATIC voids of the oral cavity, as indicated heretofore, often consist of large perforations of the palate in conjunction with extensive scarring of the lining of the mouth and injury to the tongue In such instances freeing of the tongue and excision of scar tissue of the lining of the mouth

* See G M Dorrance The Operative Story of Cleft Palate Philadelphia Saunders 1933

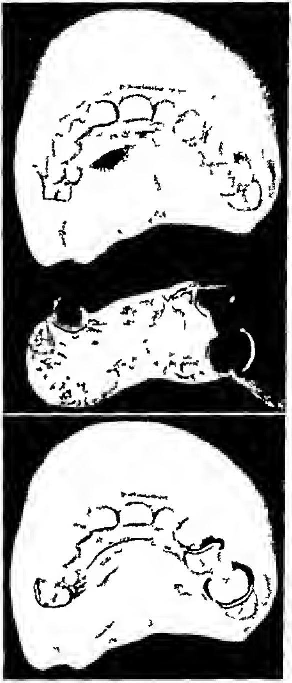


FIG 404 (*Left*) Gunshot perforation of hard palate (*Right top*) A type of acrylic prosthesis designed for coverage of perforation of palate (*Right bottom*) Acrylic prosthesis in position Note secure attachment to molars

should precede reconstruction of the palate In the interim some type of occlusive appliance should be devised to eliminate the perforation in the palate The appliance may be made of acrylic as a part of an overall dental appliance constructed by the dentist (Fig 404) As with most such appliances and particularly in younger people they are not tolerated well and often are considered a nuisance Therefore advantage has been taken in such instances of the existence of the soft acrylics and a button type of obturator has been devised The smaller extremity of the appliance is made of soft acrylic which is rather easily inserted into the perforation in the palate whereas the actual obturator surface of the appliance consists of hard acrylic both of which are fashioned after a preformed mold of the perforation and the shape of the injured palate

ORO ANTRAL FISTULAE Another fairly common partial void is the oro antral fistula This may follow a tooth extraction a gunshot wound an antral infection or the removal of a tumor of the palate (Fig 404) Its permanent closure may be a vexing problem most frequently due to the failure or difficulty of providing a secure lining for the closure A reliable repair may be accomplished by the rotation of mucosal flaps over the opening but only when such

FIG 405 Appearance of obliterated buccal sulcus (for treatment, see text and Figs 169 *left*, and 357)

a flap is lined or another flap is shifted in raw side out to act as a lining for the covering flap Closure should only be done after one is certain that the antrum is clean and that adequate drainage between it and the nose exists

Where the foregoing procedure is impossible the one of Dunning (suggested by Risdon) is recommended It consists of the shifting of a large adjacent palatal flap containing the palatine artery over the antral opening completely denuded of its soft scarred tissues down to bone, and tucking the palatal flap under a labial flap (or vice versa) so the two overlap

DERANGEMENTS

Segmental The reconstitution of the shape and the form of the oral cavity is accomplished by complete excision of all scar tissue within the mouth If the resultant raw area is small, it may be ablated by inshifting of collateral mucosal flaps Where the raw area is large, as in the creation of a new sulcus behind the lower lip coverage of the raw surfaces by a split free skin graft wrapped raw side out on an appropriate appliance attached to a dental splint is the best solution (Fig 169, *left*) A supplementary splint must be worn for from six weeks to two months to prevent shrinkage of the free graft (Figs 356 357 and 405)

OROPHARYNX Stenosis of the oropharynx or the nasopharynx are derangements rarely seen They may be congenital or acquired The acquired type may follow tonsillectomy the ingestion of carbolic acid, or extensive infections Where an adhesion exists between the base of the tongue and the tonsillar fossa if not too severe in extent, it may be resolved by a procedure outlined by Kazanjian * This consists of elevating a mucosal flap from the region posterior to the molars pedicled superiorly on the soft palate and rotated into the raw area created by excision of the scar tissue The raw donor area is then covered by a sliding flap mobilized from the buccal aspect of the lower jaw or the lining of the cheek on the same side

In more extensive cases Dorrance recommends the lining of an artificial cavity on each side of the stricture with a free skin graft and later connecting these cavities with the opening which remained in the pharynx in the region of the stricture Curtis† reported on a case of extreme *stenosis of the oropharynx which was cured* by exposing the stenosed pharynx through a transverse cervical incision A pedicled skin flap was then shifted from the lateral side of the neck into the raw area of the pharynx The opening in the neck was closed by a subsequent operation

For nasopharyngeal stenosis or atresia H S Vaughan recommends free grafting of the surgically opened palatopharyngeal area He maintains the nasopharyngeal

* J Oral Surg 3 164 169 1945
† Ann Surg 82 79 1901

opening by covering rubber tubes with Thiersch grafts and suturing these firmly into the lateral pharyngeal wall at the same time inserting a silver diaphragm into position between the skin covered tubes so as to keep the soft palate separated from the posterior pharyngeal wall The silver diaphragm is splinted in place by means of sutures passed up into and out of the nose and tied over the columella It is a highly specialized method and should not be necessary unless repair by local tissues and stent molds is out of the question

A more common intra oral derangement is the so-called tonguetie which can be ablated either by simple transection of the sublingual frenum or still better by a web splitting Z plasty This is done by incising the frenum lengthwise and then projecting two additional incisions in the form of side arms at 50° to each side of the original incision so as to form two triangular flaps which are then crossed thus lengthening the original extent of the frenum and freeing the tongue

There is a vast array of oral derangements such as periodontoclasia denture sores odontogenesis imperfecta the consequences of deficiency diseases allergies and many others which are of essentially dental concern or fall to the lot of the internist

General Over all derangements of the oral cavity are usually of traumatic origin Their management must be subdivided into the various segmental features and dealt with step by step The normal septic conditions of the oral cavity and its importance in nutritional maintenance of the patient mitigate against the success of over ambitious one stage procedures

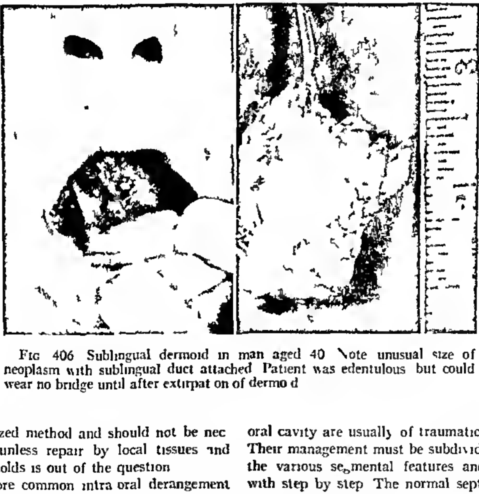


FIG 406 Sublingual dermoid in man aged 40 Note unusual size of neoplasm with sublingual duct attached Patient was edentulous but could wear no bridge until after extirpation of dermoid

EXCESSES

True excesses within the oral cavity consist of macroglossia macrogingivae hyper

trophied uvula redundancies of the mucosa and other tissue excesses most of which are amenable to simple excision and closure In a recent case of congenital macrogingivae reported by Byars and Sarnoff the only treatment used was complete radical resection of the hypertrophied gingival tissue without removal of teeth The condition is so rare that no standardized procedure can be prescribed

Macroglossia may be dealt with by resecting a wedge from the midline or one wedge from each side of the tongue Both particularly dermoids which in certain instances may mimic the appearance of unusual size of the tongue (Fig 406) For the adequate treatment of carcinoma of the tongue the student is referred to textbooks on general surgery and those devoted exclusively to this subject (Fig 407)

Fig 407 Sublingual carcinoma (8 months duration) Oral resection and immediate radical neck resection done at one sitting (*Right*) One week postoperative

may be done depending upon the three dimensional extent of the hyperplasia

False tissue excesses within the oral cavity are represented by such conditions as cavernous hemangioma of the lining of the mouth the tongue or the gums the treatment of which in general has been discussed in a previous chapter Other false tissue excesses consist of rhabdomyoma myoblastoma arteriovenous aneurysm chondroma lipoma and (foremost of all) carcinoma of the tongue In dealing with enlarged tongue one must always bear in mind the possibility of sublingual tumors

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35

Neck (Cervicoplasty)

The neck region deserves separate consideration for three reasons (1) its embryologic development and anatomic composition are unique, and (2) both congenital as well as acquired afflictions of the neck frequently become special surgical issues because of laryngeal or pharyngeal complications (3) Afflictions and defects of the neck, whether congenital or acquired, frequently are isolated to that region or exclusive of other parts of the head

VOIDS

Total

The total voids of the neck which are encountered are of congenital origin Traumatic total voids of the neck are inconsistent with life The congenital condition which may be considered a total void of the neck is the result of profound aberration in the development of the second, third and fourth branchial arches, usually associated with a rachischisis and is of such extent that it is not amenable to surgical reconstruction

Partial

Partial voids of the neck may be superficial deep or perforating The first and the second usually are encountered by the plastic surgeon after cicatricial healing The third are extensive losses of neck tissue communicating with either the oral, laryngeal or thoracic cavities In civilian life usually only the superficial type of losses are encountered whereas in warfare the perforating types of voids are not uncommon

The superficial voids are those not involving the thyroid, musculature, or deep vessels and nerves of the cervical region They are amenable to reconstruction via thick split free grafts (Fig 408), or by means of collateral flaps whose donor site may be the pectoral region or the shoulder girdle The deep voids are best resolved by the use of tubal grafts or massive collateral flaps Subsequent deep reconstructions are necessary upon the larynx, the trachea and other structures which may be involved

There is a class of perforating voids of the anterior neck, not rarely encountered in civilian life, which are self inflicted Schuessler in 1944 reported on a case of self inflicted excision of larynx and thyroid and division of trachea and esophagus with recovery" in a patient admitted to an army hospital with the history of such a wound for apparently no other purpose than "to remove his voice box" The patient had a transverse incision at the level of the hyoid bone from one sternomastoid muscle to the other and was brought to the hospital in a cyanotic condition with a paper bag which contained the hyoid bone with the larynx, a portion of the trachea and the esophagus This mass of tissue also included the thyroid gland with three of the parathyroids Schuessler sutured the remains of the esophagus together, after making a vertical incision in the neck and then approximated the lips of the incision to the trachea and the deep tissues about it A gastrostomy was done three days later The neck was ultimately reconstructed by cervical flaps brought in from the sides, one of which (the left) was turned on itself in the form

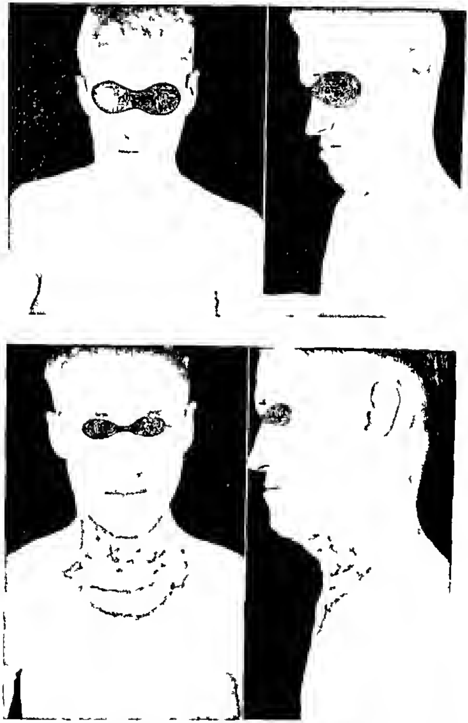


FIG 408 (*Top*) Healed void of neck (burn) At times it is difficult for this type of patient to chew and swallow (*Bottom*) Extent of cervical void after simple incision of contracture and release of scar tissue and extension of neck The raw area remaining in this type of case after simple incision alone is often surprising

of a tube whose ends were sutured to the remaining portion of the esophagus The right flap was then advanced across the anterior neck to cover The gastrostomy was closed and the patient was allowed a general diet He made an uneventful recovery without any complications discernible six months after reconstruction

One of the most common partial voids is the tracheotomy wound Repair consists of ablation of all the scar tissue about and within the opening the making of a trap door flap to one or the other side of the opening pedicled on one half its circumference turning the flap over the opening rawside out and covering this by another flap from the contralateral side of the opening The latter flap is made to be pedicled laterally so it can be shifted or slid medially over the first flap The outer flap must be about twice the size of the inner so as to cover not only the first flap but whatever raw donor site remains after turning the original flap over the tracheotomy wound

Another not infrequently encountered perforating void of the neck is that following radical excision of the larynx The reconstruction of these is a multi stage procedure First of all the continuity and potency of the laryngeal region must be established The manner of its accomplishment whether by free graft wrapped about a carrier or by a tube insinuated into the opening depends on the peculiarities and extent of the excision This then may be reinforced by neck muscles if possible and available Finally the covering tissues are brought in to complete the reconstruction These can usually be made available in the form of collateral flaps rotated into position over the repaired laryngeal void

For lack of space in a work of this general character the student is advised to consult modern texts on surgery or preferably monographs on the subject to be found in the *appended bibliography*

DERANGEMENTS

Segmental

Tissue derangements of the neck may be superficial or deep Their subdivision into distortions displacements and misplacements is much more obvious and more easily discerned than in most other regions in the body although not exclusively so

Distortions which are for the most part of traumatic origin and the results of scar tissue formation are pre eminently illustrated by the healed third degree burn of the neck region Such injuries if allowed to go on to a *vicious contracture* will unavoidably result in distortions extending beyond the neck and involve the face including the lower eyelids These postthermal contractures already discussed at some length in Chapter 18 Surgery of Scars may become so extreme that they interfere with the basic functions of swallowing and respiration The chin usually is pulled down to the chest becoming a cicatricial part of it

In the reconstruction of these contractures the occasional operator and the student are warned against one thing above all—that is after the release of the contracture a bewildering raw area results and an unexpected amount of tissue usually is needed for coverage (Fig 408)

The question is very often raised as to whether the cervical contractures are best reconstructed by large sheet grafts of split skin or whether it is better to repair the defect with flaps or tubed pedicles Probably the best answer to the question is simply What is the depth of involvement of the neck tissues? If the fibrosis does not go beyond the deep fascia of the muscles overlying the thyroid the contracture may be released the scar tissue excised and the defect free grafted If there is definite involvement of the deep muscles and the trachea particularly where some type of reconstruction may be necessary upon the latter the better form of repair resides in

the use of flaps or tubes From an esthetic and functional point of view the latter are certainly preferable to the free graft

Tissue displacements in the neck region are not rare and frequently are the result of prior or former surgical intervention They may follow the age old and ill advised vertical incision for tracheotomy thyroid ectomy excision of the cervical lymph glands in connection with carcinoma of the lower lip or operations performed for the eradication of congenital aberrations such as the cervical sinus or branchial cyst The management of the posttracheotomy scar has been discussed in Chapter 18 Surgery of Scars Almost without exception the postsurgical derangements of the neck re gion may be repaired by tissue collateral to the defect by pedicle flaps (Fig 54)

One of the commonest tissue distortions of the neck is that following overambitious x ray therapy of this region in connection with superficial skin conditions hirsutism or the thyroid gland This will be described in Chapter 38 Skin

Tissue derangements of the category of displacements usually congenital in origin consist of certain anatomic deviations and anomalies of the deep tissues of the neck and are almost always associated with rests and cysts of the branchial type which be- cause of their frequent tendency toward tis sue proliferation will be discussed under Excesses The revision or reconstruction of the tissue misplacements particularly that affecting the musculature of the an terior neck must be done in connection with the extirpation of the superfluous bran chial aberrations and therefore are treated also under Excesses

EXCESSES

True

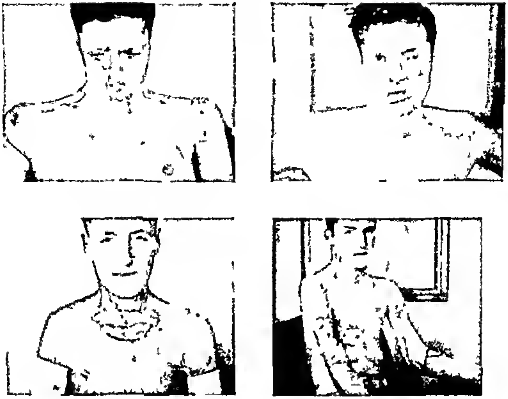
True tissue excesses of the neck may be metabolic endocrine or acquired (dermo ptosis of the circus freak) The most fre quent types seen by the plastic surgeon are the redundant skin of the neck and the commonly encountered accumulation of adipose tissue in the submental region sometimes referred to as double chin The former is usually corrected by the operation of cervicofacial rhytidectomy (Fig 337) and the latter by a submental incision with extirpation of the superfluous subcutaneous fat with or without myoplasties of the sub mental musculature

False

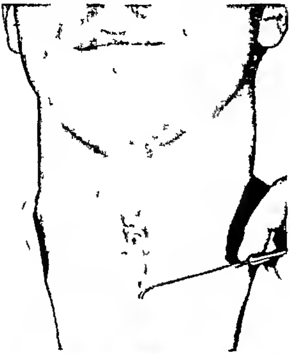
Foremost among the false tissue excesses of the neck region are the so called thyro glossal cysts and cervical sinuses These have their origin in some form of aberra tion in the derivatives of the second third and fourth branchial arches probably at the time when the second descends caudalward to cover the recession of the third and fourth arches inward This in connection with the development of the tongue gives rise to the so called thyroglossal cysts Either the cervical sinus or the thyroglossal cyst may exist separately or in combination with each other They may be of compara tively slight extent or may involve a sur prising amount of the cervical region The cure of these conditions lies in total extirpa tion In the case of the thyroglossal cyst the remains of an aberration of the thyro glossal duct the exposure the dissection and the extirpation of the superfluous tis sue frequently reaches deep into the sub stance of the root of the tongue The extir pation of a cervical sinus of any extent may necessitate exposure of the tissues of the neck up into the tonsillar fossa The cervi cal sinus may be unilateral or bilateral For details of surgery in the extirpation of these congenital entities the student is referred to textbooks on general surgery

Not infrequently with the conditions mentioned above there is considerable dis placement and distortion of other structures of the neck particularly the submental mus culature This at times results in a condi tion of pseudomicrogenia in appearance It

PLATE 16



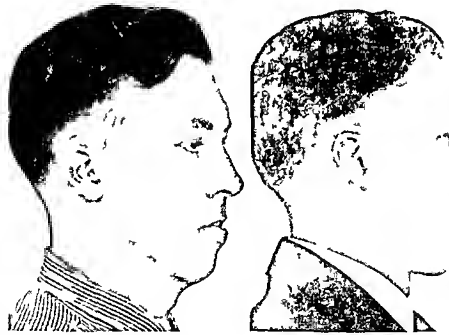
(*Top, left*) Severe burn contracture of the neck Note areas of necrosis and breakdown of scar over bony prominences The patient had severe difficulty in swallowing (*Top, right*) Postoperative condition (30 days) after transection of contracture undermining extension of head and free-grafting of surgical defect (*Bottom, left*) Another instance of correction of a severe cervical contracture by thick split skin grafts (12 days post operatively) (*Bottom, right*) Patient shown at left showing neck two months after correction within the interim corrections of elbow contracture on the right side by thick split free skin graft and on left side by a trans position flap and free graft The latter can be seen in part lateral to left antecubital region, while the flap is seen to be spanning the fossa



of muscles transposition or tenoplasties (Fig 409)

Other false tissue excesses in the neck region are tumors of the thyroid carcinoma of the larynx amyloid tumors metastatic carcinoma of the neck chordomas sulcus tumors (branchiogenic) carotid body

FIG 409 (*Left*) Extensive thyroglossal duct cyst Probe indicates caudal extension beyond the suprasternal notch where it ended as a blind sac Note cleft of mandibular symphysis with unusual neck development (*Bottom, left*) Preoperative profile view of patient to show lack of prominence of chin (*Bottom right*) Improvement of profile of neck and chin following *extirpation of duct cyst and revision of* cervical musculature



is not a true lack of development of the chin For esthetic reasons it is necessary to make readjustments of the submental musculature particularly in the region of the hyoid bone Every case must be done upon its own merits and findings In general, the operation involves foreshortening

tumors diverticula Hodgkin s disease and many others whose surgical management and treatment is not pertinent to this text in view of the adequate descriptions which the student may find in texts on general surgery

What is pertinent from the standpoint of

the plastic surgeon is that the approach to the enucleation or extirpation of many of these malignancies the management of the neck tissues during dissection and accurate anatomic closure of the surgical defect always should constitute an important part of any type of surgery of the neck It is only thus that one avoids the not infrequent postoperative tissue derangements leading to unnecessary subsequent reconstructive procedures At the risk of repetition the student is warned against making vertical incisions particularly in the midline of the neck In exceptional cases where these are absolutely unavoidable the ultimate closure should not be a mere reversal of the surgical approach but rather take the form of a Z plasty Where undue surgical trauma to the neck tissues may be the price of the conventional single horizontal incision it is far better to use two parallel horizontal incisions one high and the other low This permits elevation of the skin and subcutaneous tissues of the neck in the form of a double pedicle flap which can be easily displaced upward or downward thus giving ample exposure of the deep tissues of the neck Where extensive unilateral cervical dissections are done parallel horizontal or oblique incisions of the neck may be connected at one extremity thus allowing for the reflection of a single pedicle flap with ideal exposure When the flap is returned to its original site its free extremity should be split for a distance of one half to one inch this allows for a wedge closure or a modified Z plasty It also precludes fiddlestring contractures postoperatively

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36

Nose (Rhinoplasty)

Historically, the idea of plastic surgery seems to center about reconstructions of the nose Total reconstruction of the nose has been approached in four different ways sometimes referred to as the Indian, Italian, French and a combined method which may be termed the Anglo American approach The first is based upon the use of the forehead as the donor site for the needed tissues The second is based upon pedicled skin and subcutaneous tissue originating on the upper arm The third is founded upon the tissues immediately surrounding the defect, mostly from the cheek areas and supplemented by tissues from the neck The Anglo American approach is based upon the concept of tubing of tissues Contemporarily and selectively, all four methods are employed, depending upon the exact nature and extent of the defect and the availability of donor sites

Delay in the development of total rhinoplasties was not so much due to the methods employed as it was to the absence of asepsis and to the lack of appreciation of the importance of a good lining to the lasting integrity of the reconstruction Asepsis is even now to a great degree maintained by the concept of tubing the pedicle, which has made the Anglo American method the one of choice for two decades The matter of lining has not been completely solved to date, although its unquestioned import is appreciated by all those working in this field The most recent tendency in the total reconstruction of the nose is to revert back to the Indian forehead flap with a complement of so called collateral French flaps

The quality of the final result in a total rhinoplasty is to a formidable degree dependent upon accurate preoperative diagnosis and planning This cannot be overemphasized and should be constantly borne in mind by the student because thereupon depends the wisdom of choice of method and telling application of procedure This includes not only intelligent choice of donor site but meticulous investigation and evaluation of all the tissues comprising the defect, as well as those collateral to it

VOIDS

Total

Total loss of the nose in the strictest sense, is a rare condition This implies not only the loss of the soft tissues of the nose but all that which comprises the skeletal support of the appendage The almost unavoidable and usually concomitant derangements of the tissues collateral to the nose are in themselves a problem not encountered in subtotal voids (Fig 410)

All reconstructions of the appendage begin with providing skin covering and lining for the new nose The lining must consist of skin because mucosal tissue is not available in sufficient quantities The lining may be appended to the covering tissue prior to the latter's transfer by means of a free skin graft deposited under the donor tissue three or four weeks prior to its migration It may be provided for by the infolding of the donor tissue, so that the covering tissue is actually transferred in the form of a self lined flap or tube Finally, the lining may be supplied by one donor area, and the covering may come from another In

that case the former usually takes the form of cheek flaps turned over and into the defect epithelium into the nose whereas the covering tissue is then taken from a second donor site either the forehead or a tubed pedicle from a more distant region which is superimposed upon the turned up French flaps whose origins are the cheeks (Fig 411) The opinion is commonly held that the only part of the new nose which it is necessary to line is its lower or alar portion This is in part an avoidance of a techni

Fig 410 Subtotal loss of nose with reconstruction via lined forehead flap Skeletal support by autogenous rib cartilage (Prof Burian)

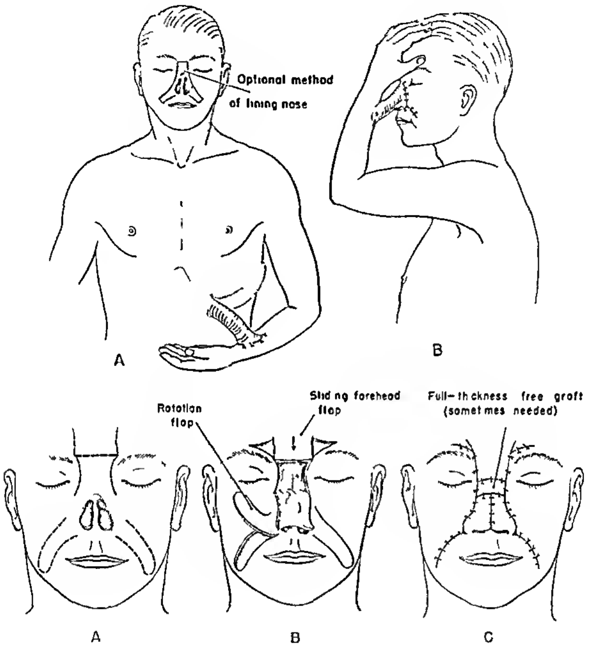


Fig 411A Methods of reconstruction in total rhinoplasty

cally difficult problem the lining of the entire new nose Another untenable attitude is that complete reconstruction of the skeletal framework is not necessary In other words, the patient starts out with nothing and therefore a fair likeness of a nose seems to be adequate to both the patient and the surgeon This attitude is not entirely consistent with the basic principle that cavitary reconstructions intended to maintain their integrity of form and function indefinitely must be completely lined and fully supported

An important functional detail in the total reconstruction of a nose is the adequate reconstitution of the nasal apertures This is dependent upon excellent formative construction of the alar extremity of the

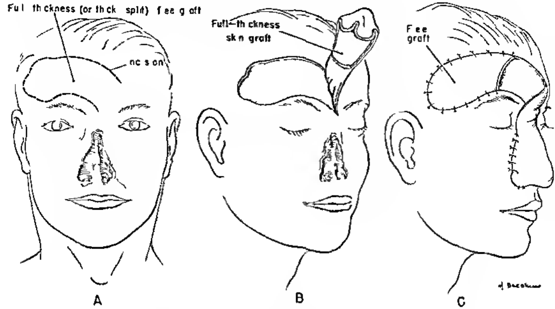


FIG 411B Methods of reconstruction in total rhinoplasty (*Continued*)

appendage As indicated above this may be accomplished by the simple expedient of free grafting the undersurface of the covering tissues or infolding the latter The first method fails entirely in this respect because it fails to take into account the importance of a good columella This problem is more adequately solved by some type of geometric patterning of the free end of the flap or tube whichever may be used so that when the various segments of the pattern are turned in and under a well formed columella results The latter stabilizes the form of the ala (Fig 411)

The final need in total reconstruction is the supporting tissue This may consist of bone or cartilage Some surgeons speak of acrylic ivory or even metals in this connection The inanimate material is never recommended by experienced surgeons The bone may be brought to the recipient site incorporated within the soft tissues or separately The former method is a difficult one and unreliable When bone is used as it more frequently is now than heretofore it is usually brought in as a free graft whose donor site is the crest of the ilium or one of the clavicles Rib cartilage is so frequently employed because it is easier to shape and carve but is ultimately not as reliable as bone particularly for the upper half of the new nose It has a greater tendency to warp and thus deform the soft tissue reconstruction Preserved cartilage has been reported as successful although from the standpoint of permanency and the author s own experience it is a rather doubtful contention Autogenous cartilage in the form of thin strips is undoubtedly the best supporting material for the alar extremity of the new appendage

PARTIAL

Partial losses may be either subtotal or regional (Fig 11A) Either one may be full thickness or superficial—as is the case with other appendages such as the lip lid or the auricle The most common regional full thickness losses are those of the glabella the bony dorsum tip alae or septum The individual tissue losses may involve the skin cartilages or the lining Losses involving the region of the glabella or the bony dorsum may be repaired most readily

FIG 412 (*Top, left*) Method of repair of compound glabellar void via advanced forehead flap (*Top, center*) Profile view (*Top, right*) Supplementary splinting after early removal of sutures, via adjusted collodion strip (*Bottom, left and right*) Postoperative

FIG 413 (*Left*) Traumatic void of bony dorsum Complete one stage reconstruction by transferring extirpated cartilaginous dorsum (rotated through 180°) into glabella (*Right*) One year postoperative (see text)

by advancing a pedicle flap downward from the midline of the forehead after excising a triangular area from above the medial extremities of the eyebrows and superimposing the flap upon a lining which can usually be supplied by undermining the mucosa of the inner nose and advancing it into the midline After complete organization of the soft tissues the flap may be elevated by intranasal approach and a small strip of cancellous bone or cartilage inserted (Fig 412)

In a patient who had a large nose before injury deep losses of the bony dorsum may be corrected by carefully dissecting out the cartilaginous pyramid of the lower nose without jeopardizing the tip undermining the glabellar region and inserting the cartilaginous pyramid subperiosteally in reversed polarity (Fig 413)

Where the foregoing methods are inadequate a forehead flap or cervical tube may have to be used The latter may bring with it the bony support from the clavicle when transferring the tube to the nose (Fig 149)

If the tip proper is lost and can be retrieved without too much contamination it may after thorough cleansing be sutured back into its original place providing the portions of cartilage contained within it are meticulously approximated to their origins and the skin closed without tension Where this is not possible a free graft of skin and subcutaneous tissue may be taken from one of the ear lobes as recommended by Dupertuis spread to the necessary degree and sutured into the defect This may be re elevated four to six weeks later and the necessary cartilaginous support inserted The cartilage for the latter purpose may also be secured through an

Fig 414 (*Top*) Total loss of nasal tip and partial loss of columella (*Bottom*) Soft tissue reconstruction of nose and columella completed via cervical tube

FIG 415 (*Left*) Total loss of nasal tip columella and cartilaginous septum The patient does not show complete effects of the latter because a short bar of cartilage had already been inserted covering the nasal bones to support the lower extremity of the nose without benefit of cartilaginous septum (see Fig 125) (*Center*) Supraclavicular tube waltzed and imbedded into lining of nose in region of vomer Note that the suture line of the tube is showing upward at this stage This phase of reconstruction is determined preoperatively in order that final reconstruction of the columella would not show suture line externally (*Right*) Final stage of rhinoplasty Support to nasal tip and columella has been accomplished via osteoperiosteal graft taken from the right clavicle

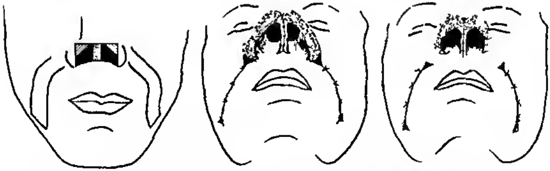


FIG 416 Operation for restoration of the lower portion of the nose (Bayer Mayr) (*Left*) Outline of cheek flaps (*Center*) Flaps turned over and sutured in position Note method of formation of columna (*Right*) Pedicles cut and sutured to stump of alae The surface may either be grafted or covered with an arm flap

incision on the posterior aspect of one of the auricles Complete loss of the tip and columella may be restored by a cervical tube (Figs 414 and 415)

The reconstruction of the alae is a comparatively difficult task particularly where this has to be accomplished via the importation of tissue from other regions of the body In such instances it is usually introduced in the form of a tube which is then

flaps to form the lining may be turned down from the sides of the nose (Fig 417) The raw area may then be covered by a thick split graft cervical tube or forehead flap

J Barrett Brown Cannon and their co workers have recently revived the use of the transfer of full thickness sections of the auricle properly selected to the nasal defect F Konig employed and reported the method in 1914 but the procedure fell into

Fig 417 (*Left*) Type of nasal void amendable to reconstruction on the principle of the Bayer Payr procedure (*Bottom*) Beginning of reconstruction of nasal void according to Bayer Payr principle The raw surface of inturned paranasal flaps may be free grafted (see Fig 420) or covered by arm flap Note shape of nostrils without any support except timber of skin and subcutaneous tissue

sutured to the alar defect This is not entirely satisfactory because such importations seldom match the original in color

A more satisfactory procedure is that based on the method of Bayer Payr (Fig 416) If the alar loss is not complete the

disrepute and was not revived until the present (see Fig 107)

Partial losses of the septum leading to the so called saddle nose are frequently seen by the plastic surgeon They are not uncommonly due to submucous resection

This void in the septum and derangement of the contour of the nose is comparatively easily corrected by elevating the depressed area of the appendage through an intranasal incision and inserting an appropriate piece of cartilage. The best donor site for the latter is one or the other auricle. Where guide suture which may be silk, dermal or fine wire is then tied very loosely over the dorsum and left for 36 to 48 hours. (For principles see Fig. 419.)

In depressions or saddles involving the major extent of the dorsum (usually associated with drooping or deviation of

FIG. 418. (*Left*) Showing type of saddle nose frequently the result of submucous resection. (*Right*) Two years postoperative. Spring type reconstruction of saddle nose via auricular cartilages or clavicular bone (see text). In this case clavicular bone was used (see Fig. 419).

the saddle is quite pronounced, sections of cartilage may have to be taken from both auricles through a posterior approach. Where this is done (a frequent method of correction resorted to by the author) the two narrow curved bars of cartilage are approximated by a fine chromic suture with their concavities apposed and inserted into the bed prepared over the defect in the septum by means of two long intestinal needles which act as guides in the proper orientation of the graft (Fig. 418). The the tip), I find that narrow strips of bone taken from the clavicle are far superior to cartilage (Figs. 419 and 143).

Losses of the columella may be restored by local tissues taken from the upper lip, paranasal region, or by a small tube waltzed in from the neck, postauricular or supraclavicular regions.

Specific tissue losses of the nose are almost invariably repaired by free grafts. Where the skin of the nose is lost, this is best replaced by a free full thickness skin

graft taken from a nonhairy area such as the neck, pectoral region, underside of the upper arm or the hypochondria The application of such a graft to the nose is managed in the same way as a free full thickness graft anywhere else on the body (Chap 16)

Because the splinting of a free full thickness skin graft covering the entire nose is somewhat difficult and inconvenient to the patient, on occasions, the author has constructed an acrylic molded splint for this purpose This may be strapped to the forehead and is of such dimensions that it allows for an air space of approximately $\frac{1}{16}$ of an inch between it and the nose This allows for the use of white petrolatum, as an exclusive proximal dressing over the graft The undersurface of the splint is first covered with petrolatum then is inverted and pressed snugly against the grafted nose so that almost perfect hydrostatic pressure is applied over the entire graft including the alar rims It is a more technical procedure than an ordinary dressing but results in a finer quality of repair and less scar than the dry dressing method (Fig 420)

The loss of lining of the nose, leading to atresia, is remedied by thorough and complete excision of all scar tissue within the nose and substitution of the lost lining by a free split thickness skin graft The latter may be splinted into position by some type of packing, which is usually inadequate, or the more reliable method of a preformed acrylic plug This may be held in place by external adhesive strapping or better still by a metal bar support originating in an appropriate dental appliance fastened to the upper teeth (Fig 169, *right*)

Voids in the nasal cartilages can almost invariably be compensated for by "flake" grafts taken from the auricles These small grafts must be properly shaped and should have perichondrium only on their concave sides If the cartilaginous voids are minimal they may often be compensated for by mobilizing small segments of cartilage from

FIG 419 Spring graft of saddle nose (*Left*) Typical late deformity following fracture of bony vault (*Right*) A tunnel is made under soft tissues of dorsum through buttonhole incision under one alar genu the periosteum is freshened a wedge is made in frontal bone and two bowed clavicular grafts with concave surfaces apposed are tied together and inserted up and into frontal wedge The longer inferior leaf of spring/graft projects into nasal tip elevating it as shown without need for columellar support Note silhouette of improved nasal form (see Fig 418)

the contralateral member or taking flakes of cartilage from the septum through a submucous approach The latter is much more laborious and discomforting to the patient than using the auricle as a donor site

Voids in the bony skeleton of the nose are still, for the most part reconstructed by the insertion of autogenous rib cartilage The mobilization of the latter is a more formidable task than the reconstruction itself and not always as satisfactory as one might hope for For that reason preserved homogenous cartilage is recommended by some surgeons Although this is successful on

FIG 420 (*Left*) Patient wearing acrylic splint over free full thickness skin graft covering entire nose Note interrupted sutures under splint The only medium between splint and graft is white petrolatum (*Right*) Showing completely grafted nose 5 weeks after removal of splint 7 weeks postoperative

occasion its reliability does not remain unquestioned Probably a more serious objection to it is the fact that if a secondary correction must be done on a nose containing homogenous cartilage long after the original operation the preserved cartilage will be found to be very brittle dry and exceedingly difficult to shape in situ without fragmenting or fracturing The approach to such a cartilage graft is always impeded by considerably more scar tissue than where autogenous cartilage has been employed

For the foregoing reasons and because the technic of grafting has materially improved in the past decade cancellous bone is the material of choice where extensive bony voids exist within the framework of the nose The usual donor site for the bone is the crest of the ilium which is much easier of approach than costal cartilage (Figs 421 and 422)

DERANGEMENTS

SEGMENTAL

Segmental derangements of the nose are most frequently the result of skeletal involvement This results in esthetic deformities which may or may not have functional implications Such derangements are most frequently the late results of fractures of the nasal bones in childhood or the consequence of ill advised or incompetent surgery

Fractures of the nose are the commonest of the acute derangements and for the most part are handled inadequately by the simple process of incompetent elevation packing and wishful thinking The original repair of a fractured nose is a major surgical emergency Not because it is a matter of life and death but because its functional and formative implications may be severe

FIG 421A (*Top left*) Traumatic deformity of nose 22 years standing Note excessive flare of nostril (*Top, right*) Nasal deformity after reconstruction via iliac bone graft 3 years postoperative Note corrected flare of nostrils and better position of ala (*Bottom, left*) Front view Note great amount of soft tissue disortion due to presence of large amount of fibrous tissue in nasal region (*Bottom right*) Front view of pat ent as pictured above 3 years postoperative

and ultimately costly The immediate re-establishment of a badly fractured nose should be done with all the operating room privileges accorded fractures of other parts of the body Classical surgical cleanliness should be observed all repositions of broken parts done under direct vision, wherever possible and adequate internal as well as external splinting provided The many appliances available for this purpose are never in themselves as important as the ability to conceive of the one method of splinting most appropriate to the case in hand The simplest form of splinting is always the best Lead sheeting 1/16 of an inch in thickness covered by chamois or adhesive plaster, stainless steel wire gauge 25 to 30, and Cellophane ribbon or fiberglass tape as packing can accomplish excellent results if employed intelligently The making of complicated molds, mixing of expensive and strange waxes for splinting will produce inferior results unless method and procedure are mixed with an adequate amount of brain substance The splinting qualities of washed, perforated x ray film for instance,

Fig 421B (*Left*) Gable shaped iliac bone graft inserted into nose for total support (2 months postoperative) Note attachment of bone graft to nasal process of frontal bone (*Right*) Same patient, 3 years postoperative Note that there is practically no absorption of the bone graft even though its only point of attachment is at the nasal process of the frontal (Same case as Fig 421A)

bent in the form of a saddle or rolled into a tube and lightly insinuated into the nostrils, are seldom appreciated The resiliency of x ray film will keep any nostril open without the necessity for a pack

Healed derangements of the bony arch of the nose are very common and almost always the result of an old nasal fracture side of the nose, whereas the latter is known as the short side The correction of this type of nasal derangement consists in splitting the nasal bones apart dorsally, freeing of both nasal processes of the maxilla, removing an appropriate wedge from the long side freeing the glabella with a chisel and moving the entire bony mass of the nose

Fig 422 (*Left*) Pronounced saddle nose, the result of an old football injury (*Right*) One year after correction of extreme saddle nose via shaped iliac bone graft

The displacement may be in any one of several directions The commonest forms of bony derangements are the so-called twisted and the deviated or bowed nose In profile the commonest types are the saddle nose (Figs 422, 424 and 425) and the traumatic hump" nose

The bowed nose results from the displacement of one of the nasal processes of the maxilla inwardly and outward displacement and rotation of the nasal process on the other side From the standpoint of reconstruction, the former is known as the long into the midline Where there is a concomitant deviation of the septum as there frequently is, it must be corrected or the deviation will either be irreducible or almost certainly recur The nose is then splinted by one or another means in the midline until the bony framework has definitely united in its new position (Figs 423 425)

A common distortion is the fractured, dislocated or deranged wing of the alar cartilage This results in a concavity in the region of the ala—an obvious defect, par-

ticularly in cases where the uninjured alar wing of the other side is prominently convex This type of derangement is most easily corrected by making a marginal incision in the nasal lining just below the distorted alar wing carefully freeing the latter from the overlying skin and the underlying mucosa amputating it at the cartilaginous genu packed with perforated cellophane ribbon (Fig 426)

One of the commonest displacement derangements of the nose is the fractured septum The reduction thereof is usually no great problem Its maintenance is more difficult For the splinting of a repositioned septum when necessary Joseph used a fine

Fig 423 Modified Joseph nasal splint

removing the alar wing and reinserting it in an inverted position In other words the internal aspect of the deformed cartilage becomes the subcutaneous or external aspect of the wing This transforms the outer concavity of the ala into a convexity which is quite adequate in comparison with the uninjured side One or two fine horsehair sutures may then close the marginal incision and the aperture of the nose may be lightly wire suture running from the septum through a hole drilled in the base of the inferior edge of the nasal process of the maxilla opposite to the direction of the septal dislocation This procedure is not entirely satisfactory because the insertion of the wire suture and the drilling of the hole in the nasal process is somewhat difficult moreover once the wire sling is in position it is out of easy subsequent con

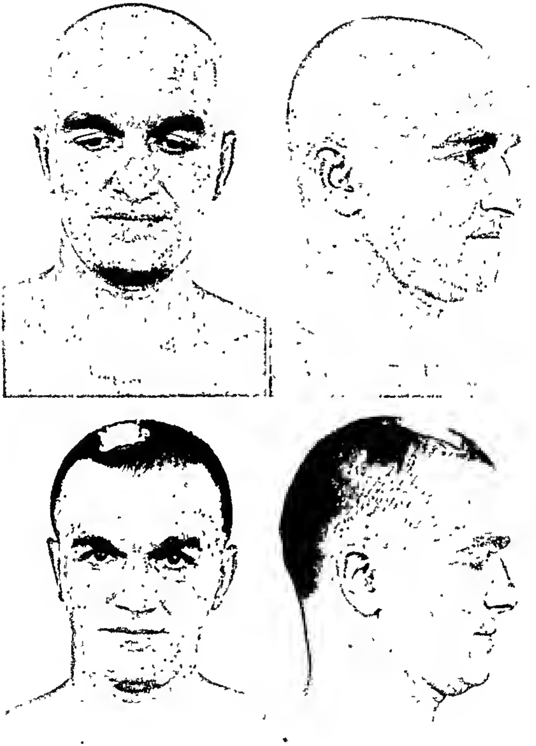


FIG. 424. Reconstruction of the typical traumatic bowed nose. Nose was shortened at time of repositioning. (*Top, left* and *right*) Preoperative. (*Bottom, left* and *right*) Postoperative. (See Fig. 427 for splinting of septum.)

trol For this reason Blair has devised a method of splinting the septum by passing a wire sling from it through the soft tissues of the floor of the nose to emerge under the upper lip The wire is then twisted around a selected tooth so as to pull the septum in the proper direction This procedure is jected under the tissues of the floor of the nostril and brought out through the alar crease It is then twisted and turned back on itself so as to form a small hook approximately ¼ of an inch deep From this wire hook an appropriate rubber band is directed over the back of the ear where it is

FIG 425 The typical traumatic hump nose (*Left*) Preoperative (*Right*) Postoperative

easier of execution but suffers with the obvious drawback of a piece of twisted wire within the oral cavity It is also difficult to readjust

Where splinting of the septum is an unavoidable feature of a major septal correction and simple packing obviously is inadequate and where the Joseph and Blair procedures are impracticable (in the latter case the absence of teeth) in selected cases I use the following form of splinting A fine stainless steel wire sling is passed through the most desirable part of the septum pro- cushioned by two or three layers of gauze or attached to a gauze sling glued to the pre auricular region In patients with thin auricular cartilages the rubber band has a tendency to roll off In such cases an adequate amount of collodion applied over the rubber band and the gauze on the back of the ear will maintain the contrivance in position I have found this procedure to have certain advantages First of all the wire sling is under direct vision at all times and easily removed when necessary Secondly the degree of splinting and therefore

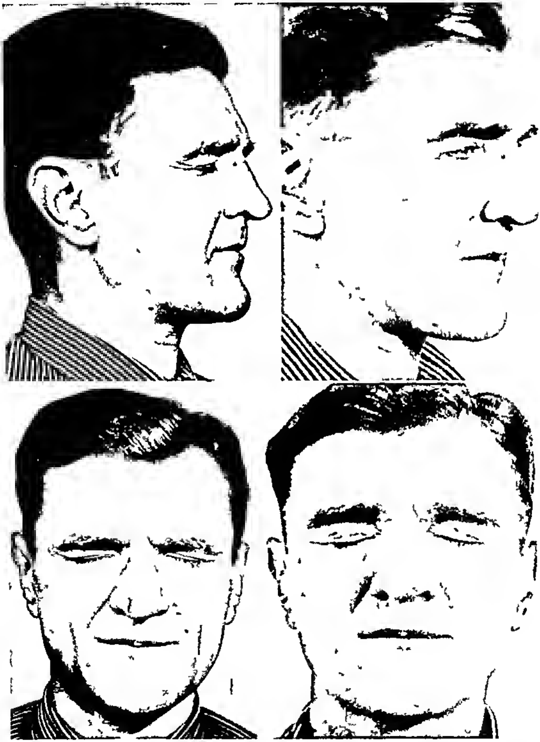


FIG 426 (*Top left*) The deranged alar cartilage Note pronounced concavity of the alar wing due to fracture dislocation of cartilage and healing in displaced position (*Top, right*) Correction of alar deformity by replacing wing of alar cartilage in turned over position (*Bottom, left*) Front view of alar deformity due to fracture dislocation of alar wing on right side (condition 8 years after injury) (*Bottom, right*) Same patient, after reconstruction by replacing dissected wing of right alar cartilage in turned over position

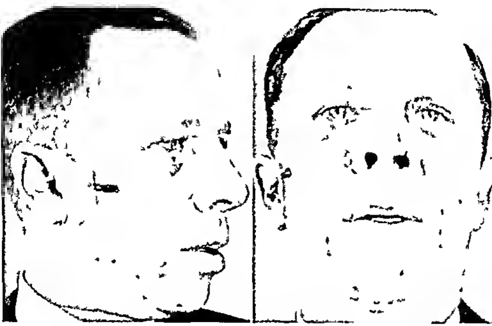


FIG 427 Controlled elastic splinting of nasal septum (Pick) (*Left*) Method of attaching elastic septal splint to gauze sling over right ear glued to skin with collodion (*Right*) Front view showing good position of septum and point of exit of stainless steel wire passing from septum under nasal floor and out through alar crease The wire is attached to rubber band

allocation of the septum is under direct control through interchangeability of the rubber band Finally it causes the patient no discomfort and the splinting can be maintained for indefinite periods of time (Fig 427)

Another common derangement of the nose which may be unilateral or bilateral is that associated with cleft lip Although it appears to involve only the nostril and ala it more frequently involves the entire side of the nose in unilateral cases This becomes evident only if one follows such nasal derangements into adult life The correction of such a nasal deformity is a major procedure in later life It should be done at the same time the cleft lip is repaired No matter at what age it is done the reconstruction consists first of the formation of an adequate floor of the nose by means of tissue made available from the outer and upper wall of the cleft lip and the fornix of the nostril The paranasal region in the cheek must then be extensively undermined The alar cartilage or what there is of it is mobilized completely up into the tip and superiorly over the upper lateral cartilage to the nasal process and this with the lining advanced up into the tip and the dorsum of the appendage and secured to the top of the septum Where insufficient cartilage is present or it is so meagerly developed as to be unmanageable a flake of auricular cartilage may have to be secured from the infant s or patient s ear and inserted into the ala In extreme lateral displacements of the outer extremity of the alar rim the latter may have to be freed from the cheek rotated medially and sutured to the base of the columella This must be accomplished in any case to guarantee a good nasal aperture The entire base of the nose must then be transfixed by a through and through mattress stainless steel wire suture which is

tied over lead foil so as to splint the repair as a whole until healing takes place (see Figs. 391 and 428).

True tissue misplacements are usually of surgical origin and are the result of inexpert closure following excision of small cutaneous defects of the skin of the nose. This is particularly true with excisions performed about the tip of the nose. The closure of areas of excision about the tip of the nose are particularly difficult because of the quality of the skin in that location. It is a thick and inelastic skin, closely attached to the underlying cartilaginous structures. Because of its inelasticity, undermining in this region is not very helpful. The most common derangement following forced closure in this region is the displacement, kinking or notching of the alar rim on the affected side. In consequence of these difficulties even the experienced plastic surgeon frequently resorts to the use of a small pinch graft to ablate a raw area over the nasal tip. Because of the obviousness of the tip of the nose, it is not a desirable procedure and usually is done in self-defense because of the difficulties associated with primary closure.

The former difficulties can be avoided by the application of the author's procedure for the closure of arched and circular defects (see Chap. 21 "Surgical Geometrics").

FIG. 428. (*Top*) Typical nasal derangement associated with inadequate repair of cleft lip. (*Bottom*) Reconstruction of nasal derangement. 7 months postoperative.

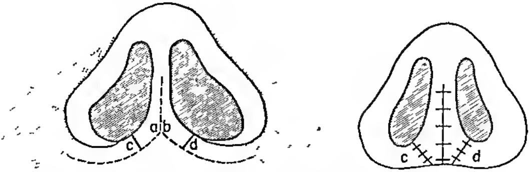


FIG. 429. A method of lengthening the columella (Carter). (*Left*) Broken line indicates incisions. Note incisions in floors of nostrils, shown by broken line between c-a and b-d. (*Right*) Pedicles a and b are advanced upward, thus allowing for elongation of columella and narrowing of base of nose by bringing c and d medially after undermining stippled area.

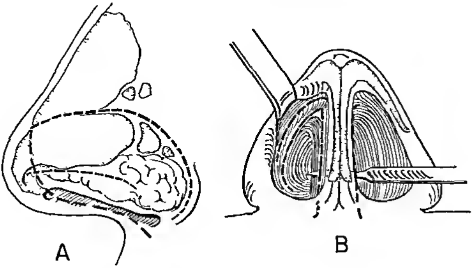


FIG 430 Incisions with mobilization of nasal cartilages and columella used in performing a rhinokyphectomy Broken line indicates columellar transfixation and connection between it and one between alar and upper lateral cartilage

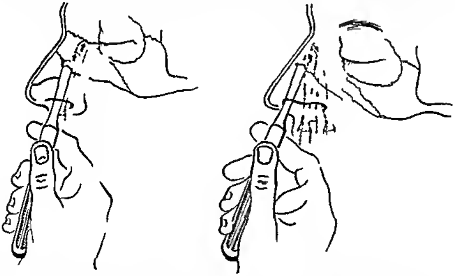


FIG 431 Method of elevation of soft tissues and periosteum over bony nasal dorsum This must be carried over and across midline of nose from one or the other side so that nasal skeleton is completely free of all soft tissue

To utilize this procedure in connection with excisions about the tip of the nose the extirpation of the lesion must follow a geometric design The excision is roughly triangular with one of the sides bowed The skin is incised first as far above the rim of the ala as the lesion will permit Another incision is then made from the medial extremity of the first and running vertically over the tip of the nose as far up as is consistent with complete excision of the lesion These two incisions are then con

FIG 432 Special osteotomes used for mobilization of nasal processes of maxillae and nasal bones from the frontal Note pointed guard on blade of instrument This prevents osteotome from sliding into nasal cavities and, if held at about a 30° angle to nasal bones usually avoids cutting of nasal mucosa Also note attached guide This by remaining outside of nose aids in determining course and position of blade during mobilization of bony vault (*Bottom*) Chisel with slight curvature of cutting end only used in mobilization of glabella

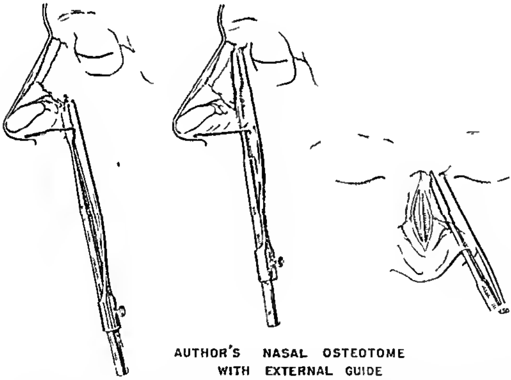
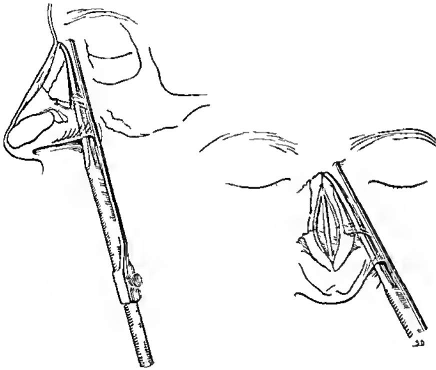


FIG 433 (*Top*) Placement course and angle of incidence of author s nasal osteotome in mobilization of nasal bones Note that guide remains external to nose thus identifying course and position of cutting end at all times Also note that pointed guard on sharp extremity of instrument, by preceding cutting edge avoids projection of chisel into nasal cavity

nected by a third Actually in a three dimensional perspective all three incisions are segments of an arc rather than straight lines Following excision of the lesion the second and the third lips of the excision are undermined somewhat beyond the midline of the tip of the nose in the instance of the first lip and well over the wing of the alar raw area The pleating of the vertical lip in the direction of the glabella is a very important detail in the procedure because it creates a triangular flap whose free edge is displaced laterally whereas if the pleating were done in the other direction it would be displaced medially over the midline of the tip and so create a suture line much



AUTHOR S GLABELLAR OSTEOTOME

Fig 434 Method of mobilization of glabella via Pick s curved osteotome

cartilage in the case of the connecting lip The incision running parallel with the rim of the ala is never undermined This results in a looseness of the skin over the affected side of the tip of the nose If the vertical lip of the surgical defect is now pleated in accordance with the method described in Chapter 21 Surgical Geometrics so that the pleat lies in the direction of the glabella and is appropriately incised it will form a triangular flap which covers much of the connecting lip of the more obvious than it is on the lateral side of the ala

Having spread the triangular flap thus created over the connecting lip of the defect the second incision is made parallel with the free end of this flap in accordance with the directions outlined in a previous chapter thus creating the second flap necessary for the closure of an arched defect This second flap can then be displaced in the direction of the first incision and the alar rim so as to cover the major part of

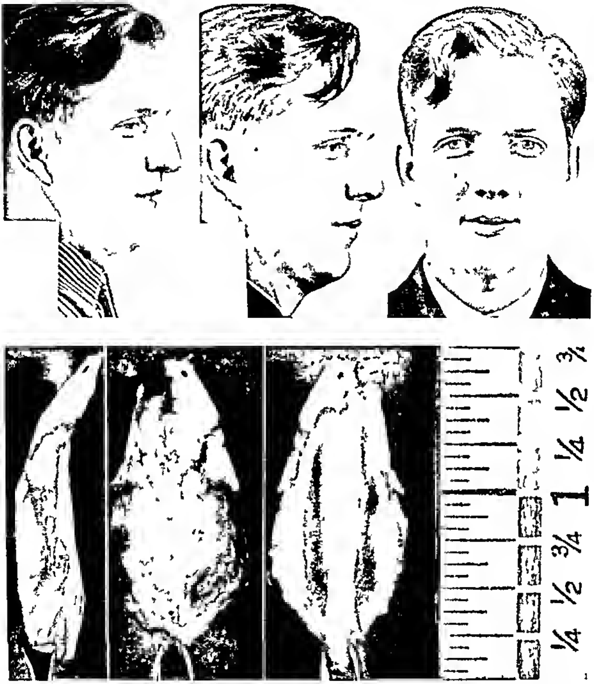


FIG 435 (*Top, left*) A type of hump nose always consisting of much bone and cartilage (*Top, center*) Same, 6 months postoperative (*Top, right*) Front view 6 months post operative Note good draping and transverse diameter of nose as compared with facial width (*Bottom, left*) Hump removed Note that entire hump is in one piece bone and cartilage, including portion of cartilaginous septum (*Bottom, center*) Dorsal aspect of excised nasal hump (*Bottom, right*) Ventral aspect of nasal hump

the raw area the remainder or upper segment of which is covered by the first flap The two flaps are then sutured together in their displaced positions so that the resultant suture line is a modified Z

Formative derangements of the nasal apertures are often associated with a short nose or stubby columella The former may be corrected by Piragoff s procedure whereas the latter may be corrected by Carter s method (Fig 429) or modifications thereof such as Blair s

Only the major derangements of the nose have been discussed because in a text of

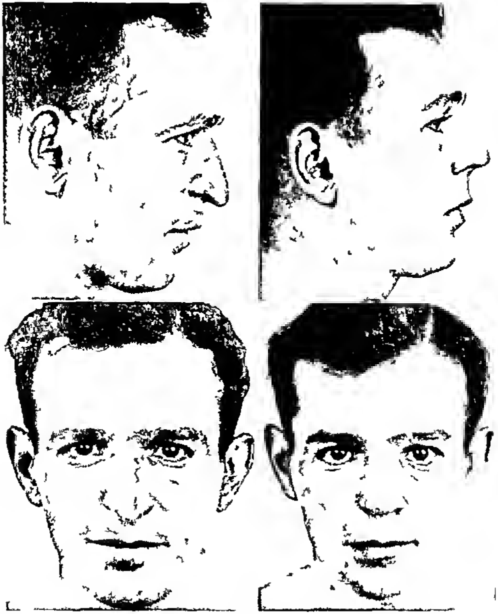


Fig 436A (*Top left*) The long hump nose with hanging tip (*Top right*) Postoperative (*Bottom left*) Preoperative full face view (*Bottom right*) Postoperative (For ventral view see Fig 436B)

FIG 436H (*Left*) Ventral view, preoperative (*Right*) Ventral view postoperative A rhinoplasty which fails to improve appearance of nostrils is an inadequate operation

FIG 437 Hump nose with long drooping tip (*Left*) Preoperative (*Right*) Postoperative

this size (devoted to coverage of the field of general plastic surgery), it is not possible to include all of the great number of defects actually encountered in practice It is assumed that the ability to visualize and perform the basic procedures discussed, plus thorough understanding of Section I on Principles and Section II on Problems, is sufficient ground for intelligent approach to the many other reconstructive problems

of the nose Endless enumerations and discussions are no substitute for mental agility and extemporaneous ability ployed in the reduction of a macrorhinia is not dissimilar from that used in the reconstruction of a hump nose

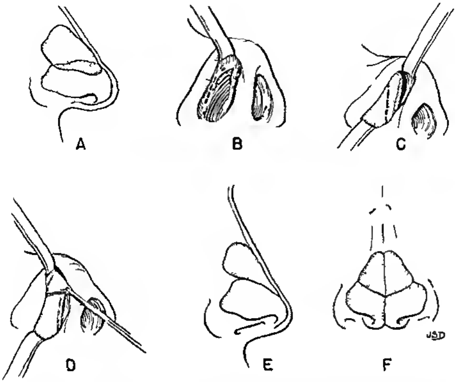


FIG 438 Management of the nasal cartilages (A) Method of determining amount of excision of upper lateral and alar cartilages (B) Incisional approach to lower border of upper lateral cartilage and upper border of alar cartilage (C) Direction of excision of lower border of quadrilateral cartilage Note that excision is more or less wedge shaped base upwards (D) Identifying projection of upper lateral cartilage after shortening of septum and determining amount of excision (E and F) New angle of incidence and relationship of the two cartilages to each other following appropriate excisions If the two cartilages fall together following excision without overlapping or diastasis no intranasal suturing is necessary following a rhinoplasty

EXCESSES

TRUE

The most commonly encountered true excesses of the nose are macrorhinia and the so called hump nose Macrorhinia is much less common than a true hump nose It necessitates reduction of the size of the nose in all its dimensions and excision of some of all the tissues which constitutes the appendage Basically the actual procedure em

Rhinokyphectomy Probably no one procedure in plastic surgery has attracted more interest in the past decade than the operation for the reduction of the so called hump nose Considerable literature about rhinokyphectomies is available to the student some of which may leave his judgment dangling between two extremes One is that the procedure is an exceedingly simple one consisting of nothing more than excision of the superfluous dorsal hump

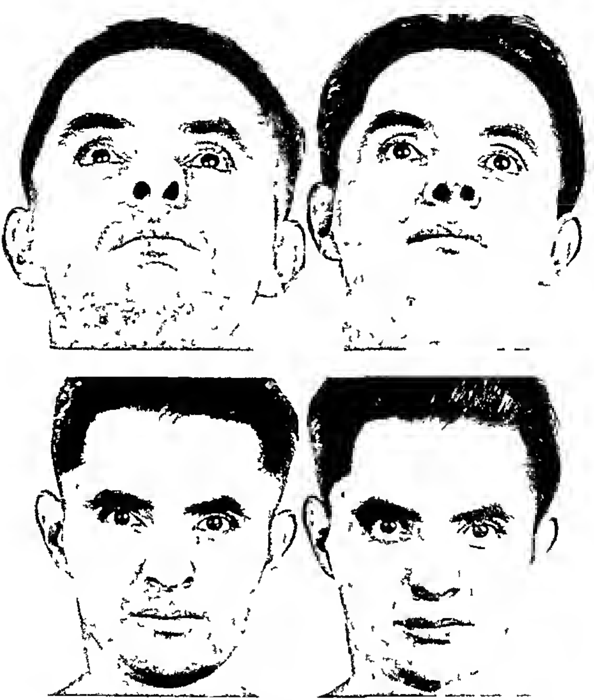


Fig 439 The bulbous tip (*Top, left*) Preoperative condition (*Top, right*) Three months preoperative (The slight smudge below the tip of the nose is due to a match burn) (*Bottom, left*) Front view preoperative (*Bottom, right*) Front view, post operative

with saw or chisel and infracturing of the nasal processes of the maxillae The other is that the procedure is some mysterious and mathematically complicated recent innovation necessitating the paraphernalia of the architect and the armamentaria of the engineer Both opinions are wrong the first is untrue, and the second is exaggerated

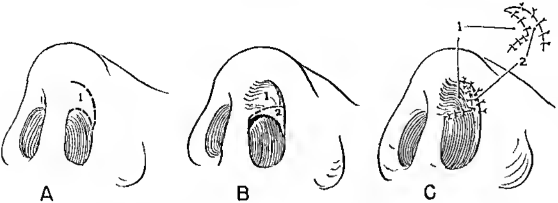


FIG 440 Method of augmenting the short nostril (Pick) (A) Skin incision upper arm of which denotes position of new alar rim The lower arm completes a triangular flap pedicled on columella which also exposes lower rim of alar cartilage (B) Skin flap (No 1) being turned in and upwards into nose in order to show original position of mucous lining (No 2) of nostril This is incised as indicated vertically into nose along septum so that a flap is formed pedicled on alar wing This is then turned against ala as new lining for the augmented nostril (C) Operation completed (Insert shows 2 dimensional evaluation of the 3 dimensional reconstruction) The pedicling of flaps is reversible, if skin pigmentation or color of lining dictates

Historically the delineation of the operation is credited to Joseph of Germany who was not a rhinologist but nonetheless the father of most of the rhinoplastic procedures employed at the present time The operation is based upon the complete exposure and accurate sculpting of the skeletal support of the nose It can by no means be precalculated with a micrometer for technical reasons Even if this were possible it would not be surgically reasonable because such an attitude absolutely disregards the phenomena of healing with its many formative consequences and structural implications What the operation does demand is a keen and subtle appreciation of proportions and relations which for the most part are garnered through the sense of feeling in the experienced finger tips of the surgeon and through a trained eye It is an exercise in freehand sculpting

The exposure of the skeletal support of the nose is accomplished under local analgesia through an incision exposing the lower and dorsal aspect of the cartilaginous septum including its lateral cartilaginous projections referred to as the upper lateral cartilages This incision may begin between the base of the columella and the quadrilateral cartilage is then carried upward to the dorsum of the cartilage which it follows to the lower border of the upper lateral cartilage and thence proceeds laterally and downward to the lower border of the nasal process of the maxilla An additional incision is sometimes necessary along the lower border of the alar cartilage from the tip of the nose to the free extremity of the alar wing (Fig 430)

Once the primary incision has been made the blade of the scalpel is kept close to the dorsal surface of the upper lateral cartilage and by means of cleavage dissection the overlying soft tissues are freed upward and somewhat over the lower border of the nasal bone At that point an elevator preferably with a sharp fore edge is inserted subperiosteally and the soft tissues overlying the bony framework of the nose are elevated onto the glabella then laterally over the entire extent of the nasal process of the maxilla This is executed bilaterally It is

extremely rare for the periosteum to be elevated without perforation, particularly over the dorsum where it is thin, tight and formidably difficult to cleave. Occasionally, in noses with highly elastic skin and soft tissues overlying the dorsum of the nose, the entire extent and shape of the hump may be visualized (Fig 431)

The nasal hump may be excised with chisel or saw. Controversy may exist as to which is the better. In fact, and for the benefit of the student, the entire question may be resolved by saying that the ability and the imagination of the operator are far more important than the type of instrument used. What the expert may be able to strike with a stone, the neophyte could not hit with a bow and arrow. In fairness to the occasional operator, it must be said that although more detail can be accomplished with the chisel than with the saw, also more damage can be committed with the former than with the latter. I have used both but prefer the chisel, modified in two ways to suit the exigencies of the procedure (Fig 432). The two resemble each other in form except that one is slightly curved and the other is straight. Both have a subperiosteal guide and an external guide which are helpful in delineating accuracy of projection. The curved chisel is particularly useful in delineating proper curvature of the cut through the glabella obviating the necessity for infracturing which may result in some unevenness in this region

In the removal of the hump via a chisel the cartilaginous portion of the hump is first incised with Mayo scissors, scalpel or a sidewise motion of the chisel blade itself until the nasal bones are reached. The required amount of the dorsum of each lateral cartilage is then cut with straight scissors and remains attached to the cartilaginous septum. Once the chisel has abutted against the nasal bones and the perpendicular plate of the ethmoid, it is driven upward by means of a hammer until it reaches and glides over the nasal process of the frontal bone. The entire hump including the lateral cartilaginous projections can thus be removed in one piece. Only when the student is able to remove the hump of a nose in one piece has he grasped the surgical anatomy of the problem (Fig 435). The sides of bony vault are mobilized as shown in Figures 433 and 434

With the hump removed the nose is then foreshortened by removing a triangular piece of the lower extremity of the quadrilateral cartilage base upwards of an extent consistent with the selected degree of advancement of the tip of the nose upward (Fig 438C). Thus the nose is now lower, narrower in its upper two thirds and shorter. The remaining problem is the formative revision of the alar region and the tip of the nose. Adequate reconstruction of a hump nose is never attained unless all three dimensions are revised including the base (Figs 436 and 437)

The amount of excision of the upper border of the alar cartilage is determined by gently apposing the tip of the nose to the new angle of the inferior border of the quadrilateral cartilage and thus visualizing the amount of overlap of the alar and the upper lateral cartilages (Fig 438A). The superfluous amount of the latter is excised as it projects down toward the tip (Fig 438D). The unwanted amount of the alar cartilage is then excised by everting the upper border with a hook and trimming it. By splitting the genu of the alar cartilage first, the wing can be more easily dislocated. To lower the tip the columellar end of the genu is brought downward and trimmed. Where a pronounced lower border of the alar wing exists it is exposed by the marginal incision mentioned heretofore and trimmed to the desired extent. The trimming of the upper border of the alar cartilage may involve the mucous lining whereas the trimming of the lower border of the alar cartilage should be done after freeing it from the underlying mucosa. This is

aided greatly at the time of induction of the local analgesia by forcefully lifting the mucosa away from the overlying cartilage with somewhat augmented infiltration of the procaine (Fig 430)

The question of resuturing the free ends of the cartilages both upper lateral and alar, depends upon the amount of excision the accuracy of the excision and the peculiarities of the case In most cases suturing is not necessary except at the genu of the alar cartilage in order to secure the integrity of the tip Accurate postoperative splinting usually reconstitutes the continuity of the various parts of the nose with the exception of the columella without the need of suture material

The final step in the operation is the approximation of the columella to the new lower border of the quadrilateral cartilage This is accomplished by two mattress sutures of the so-called advancing or orthopedic type This consists of inserting the suture-carrying needle through the septum at a point somewhat higher than the level at which it enters the columella When these sutures are tied they pull the columella up in the direction of the dorsum of the septum thus advance the tip to an extent consistent with the direction of the orthopedic stitch and the elasticity of the tissues of the columella

The Cartilaginous Pyramid A common tissue excess is the protruding columella This is corrected by removing an elliptical section of soft tissue and occasionally a minimal amount of the lower border of the quadrilateral cartilage just above the cutaneous columella The surgical defect is closed by direct approximation

A frequently encountered tissue excess of the nose is the bulbous tip (Fig 439) This necessitates revision of the upper pole of

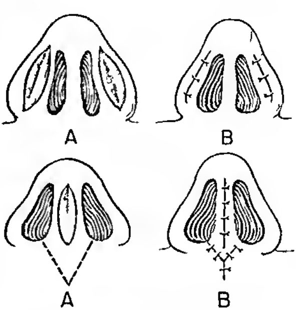


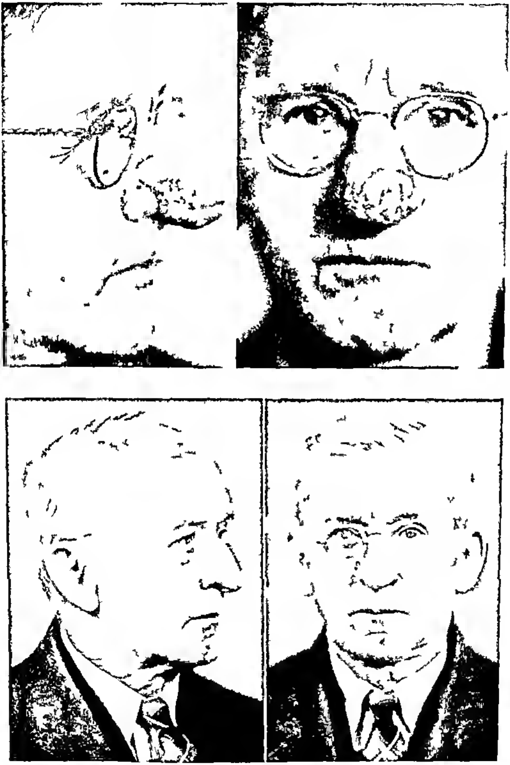
Fig 442 (*Top*) Method of reducing the thick alar rim (*Bottom*) Method of reducing the short thick wide columella Where shortness of columella is attended by bulbous tip method in Figure 440 may be used with this

the nasal aperture as well as the fullness of the tip as a whole The former is accomplished as shown in Figure 440 and the latter is performed by trimming of the alar cartilage which is exposed through the incision shown in Figure 440A

Another common excess of the appendage is the duck bill nose (Fig 441) Correction of this condition is based upon that part of a rhinokyphectomy dealing with revision of the cartilages The essential difference is that in the duck bill nose much more of the upper rim of the alar wing and lower rim of the upper lateral has to be excised Approximation of the trimmed cartilages with 00000 catgut is advisable

Certain specific tissue excesses such as the thick alar rim or the short wide columella may be reduced by simple excision as shown in Figure 442

Fig 441 The duckbill nose (*Top left*) Profile Preoperative Note length of tip concavity above alar rim and slight notching of dorsum (*Top right*) Profile One year postoperative (*Bottom left*) Ventral view Preoperative (*Bottom right*) Ventral view One year postoperative



FALSE

Rhinophyma is a hypertrophic condition of the skin and subcutaneous tissues of the nose, probably originating within the epithelium of the skin glands. By some authors it is classified with acne rosacea.

The condition may be permanently ablated by carefully dissecting or shaving off the superfluous tissue. Removal of the undesirable tissue may or may not include the overlying epidermis. Where it is removed, the resulting raw area is covered with a thick split-skin graft. Where it is possible first to undermine the overlying epidermis in the form of a curtain or a flap pedicled on the alar rims, it may then be replaced over the fascia covering the underlying cartilages and usually gives a much better cosmetic result than where the raw area is covered by a free graft (Fig 443). In large old rhinophyma, secondary dystocia of cartilages often demands coincident revision of nose proper.

The treatment of hemangioma of the nose is in principle parallel with that outlined under hemangioma of the face. Where the lesion is of the extensive cavernous type and involves the lining of the nose, it may be just as difficult in its treatment as that involving the cheek and the lining of the mouth Such extensive pathology may mean radical excision of a region of the nose or even a total rhinoplasty.

Carcinoma of the nose, if seen very early, may be treated by radium, chemosurgery, or wide excision of the affected part and a subtotal rhinoplasty. Where the lesion has involved the nose to a telling degree, total excision is unavoidable, including the lymph glands of drainage This leads to the need for a total reconstruction of the nose. Such reconstruction should not be planned until one is reasonably certain that no recurrence will take place. In the meantime the psychological peace of the patient may be secured by making him an appropriate prosthesis. For detailed surgical management of carcinoma of the nose, the student is referred to texts more or less designed to cover this specific subject, such as that of Blair (See Fig 152B, *top*)

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FIG. 443. Rhinophyma (*Top, left*) Profile, preoperative Note deep cleavage between ala and hyperplastic tip (*Bottom, left*) Three months postoperative The original epithelium of the nose was meticulously dissected up as a flap and draped over the reformed cartilages To merely show a rhinophyma may not result in a satisfactory appendage (*Top, right*) Front view, preoperative (*Bottom, right*) Front view, postoperative (6 months)

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37

Orbit and Lids (Blepharorbitoplasty)

Reconstructive surgery of the orbit and eyelids occasionally implies certain surgical procedures such as operations upon the eye muscles the eyeball corneal grafts (Keratoplasty) and even intra ocular procedures These are not included in this text for two reasons because they are not strictly plastic procedures of general interest nor of routine applicability and because they are fully discussed in modern textbooks on ophthalmologic surgery

ORBIT (ORBITOPLASTY)

Voids

Total voids of the orbit and its contents may be congenital or acquired In the congenital type one example of which is the cyclops there is little that reconstructive surgery can accomplish because of the concomitant pathologic anatomy of the central nervous system

The acquired total voids of the orbit though unusual are not rare in war injuries Their reconstruction is in principle a mosaic of procedures which will be found discussed under the various subheadings following Partial Voids

Partial voids of the orbit per se may be divided into those involving the supra orbital ridge the infra orbital ridge with the floor of the orbit the malar zygomatic compound the lining of the orbital cavity and the eyebrow

The loss of the supra orbital ridge is usually associated with losses of some degree involving the forehead or the frontal region superior to the ridge The reconstruction of the ridge may be considered a distinct procedural problem Whether there is involvement of the frontal region or not the supra orbital ridge should be considered a separate issue In posing the ridge as a specific problem it is much easier to visualize reconstruction of the orbit so as to parallel the normal mate of the other side By selecting an appropriately convex segment of the rim of the ilium a narrow strip about ⅛ of an inch in diameter of the outer cortical table of the bone is carefully mobilized It is then wired into position between the nasal process of the frontal bone and the available lateral segment of the injured orbit periosteal side down (Fig 349 *bottom*)

Gross losses of the infra orbital ridge are best reconstructed in the manner described under the supra orbital ridge Where the floor of the orbit is involved a flat segment of the inner surface of the ilium is mobilized in the desired dimensions and thickness and then wired into position periosteal side up (Figs 444 and 445)

It is not necessary nor advised that cartilage be used in the reconstruction of the orbital rims because though it is somewhat easier to carve and manage it is more difficult to secure in adequate amounts Postoperatively it has a tendency to warp which bone will not do Iliac bone is much easier to mobilize and is more permanent and dependable in reconstructions

Voids of the malar zygomatic compound are frequent in wartime and they are not unusual in civilian cases Where actual loss of the compound exists it is almost invariably attended by considerable loss of overlying soft tissues These must be sup

FIG 444 (*Top, left*) Gross gunshot void of orbit and malar zygomatic compound Note comparatively large skin bulge under upper eyelid This was part of the lower lid, completely misplaced during original repair on the battlefront (*Top, right*) Profile view (*Bottom, right*) Six months postoperative Complete soft tissue revision was done with reconstitution of lower eyelid from the soft tissue nipple observable above The supporting structures for the entire floor of the orbit and the zygomatic compound are bone taken from the crest of the left ilium Esthetic revision of lid still necessary (For parallel case, see Fig 445)

plied as coverage for the defect after excision of the scar tissue, before insertion of the bone graft Although reconstruction by cartilage of the bony loss is frequently done and is incidentally, more satisfactory than reconstruction of the orbital ridges per se it is far better to replace the loss by bone Certainly there is no need for (nor can much be said in favor of) reconstructions of the orbit by foreign substances such as tantalum or acrylic The insinuation of dermic grafts, fascia or fat in cases where actual loss of the malar zygomatic compound exists is not adequate reconstruction from an anatomic or biologic standpoint (Fig 13A)

Loss of the lining tissue of the orbit may be handled in one of two ways Where the loss is partial, involving less than half of the lining this may be reconstituted by means of mucous membrane mobilized from the lower lip In such instances the mucous membrane is sutured into a properly prepared orbital bed and splinted by the insertion of an adequately shaped ball of sponge rubber covered by a layer of petrolatum gauze The sponge rubber splint in the form of a ball can then be maintained in position by overlying dressings

Where the lining of the orbit is totally

Fig 445 (*Top left*) Reconstructed gross loss of orbit and malar zygomatic compound with extensive derangement of soft tissues overlying malar zygomatic region (This case was quite like Figure 444 preoperatively) Eight months postoperative wearing artificial right eye The latter needs additional elevation Reconstruction with iliac bone

gone not enough oral mucous membrane is available for total replacement Hence a thick split skin graft must be employed for the reconstruction (Fig 446) The graft should be taken from a nonhairy region and wrapped raw side out over a preformed acrylic mold or a mold made of wax or stent at the time of the operation In any case the mould should be cut into two or possibly three sections before coverage by the skin graft so that it can be more easily removed at the time of the first dressing If between the two pieces of the mould a projecting handle is incorporated so that it extends for approximately one inch outside of the eyelids this may then be used as a lever for external stabilization of the orbital mould (Fig 447)

The total loss of an eyebrow may be replaced in one of three ways by hemisection and pedicle transfer of the uninjured eyebrow (Fig 448) as a free graft or as a pedicle flap The donor site in the last two is a selected segment of the hairline The important thing is that the hairs in the free graft run in a desirable lateral direction Where the pedicle or island type of graft is used it may be designed with the superficial temporal artery as its vessel of supply and then tunnelled under the skin of the temple so as to emerge in the proper place over the supra orbital ridge The percentage of successes in the free graft restoration of the eyebrow is not so satisfactory as might be expected whereas a pedicle procedure is almost invariably successful

Derangements

Segmental Derangements of the orbit may be subdivided in the same way as

voids Foremost in this category are fractures of the malar zygomatic compound

Fractures of the malar bone and zygomatic arch of the temporal though relatively uncommon in civilian life, are frequent in warfare Not too much reliance can be placed in detailed diagnosis upon x ray findings in these fractures Careful inspection and palpation of the malar zygomatic region and the orbit is usually more serviceable than relying entirely upon roentgenograms (Fig 449) The malar and the zygomatic arch must be elevated into position to avoid extensive deformity of the face This may be accomplished through intra oral approach or extra oral (temporal) elevation as recommended by Gillies (Fig 450) The latter is accomplished by making an incision in the hairline of the affected side, down through the fascia of the temporalis, and passing a blunt instrument between it and the muscle until it impinges under the fractured bones A fulcrum in the form of a roll of gauze is placed between the instrument used as a lever and the underlying temporal tissues and the fragments of bone are adjusted into position The adequacy of the latter is determined by external palpation while the fragments are being elevated As a rule, this is all that is necessary since there is little tendency for the fragments to be pulled out of position subsequently Where there are coincident involvement and depression of the orbital floor the latter may have to be elevated through a transantral approach The antrum is opened via a Caldwell Luc approach and the orbital floor is packed into position One of the most serviceable materials in this connection is dry cellophane or fiberglas gauze They nevertheless have one disadvantage common to all forms of open packing I have therefore resorted

FIG 446 The skin lined eye socket (Graft thickness 16/1000 inch donor site underside of upper arm)

FIG 447 A type of acrylic extension arm used during World War II to control temporary eye socket prosthesis devised by Dr J Kohout Patient has had an extensive reconstruction of forehead via tantalum plate and bony reconstruction of malar zygomatic compound Prominent bulge in the temporal region is the result of a recent insinuation of large free fat graft taken from abdomen

lately to the use of absorbable materials such as Gelfoam and Oxycel The results thus far have been excellent Just enough of the material is packed against the elevated orbital floor to buttress it Because of its tendency to adhere to raw surfaces it makes a good splint without the necessity of filling the antrum completely the fear of its dislocation or the necessity for its subsequent removal This permits of a closed type of operation thus reducing the hazard of oral contamination of the antrum and the nuisance to the patient of carrying an intra oral pack (Fig 451)

Since derangements of the bony orbit are shallow depressions They are usually attended to at a second operation by inserting a double layer of derma (Fig 10)

Derangements of the lining of an otherwise satisfactory orbit are represented for the most part by scars or adhesions of the mucosa to the eyeball The former may be excised and the defect closed by undermining and some type of modified 'Z plasty If the scar is more or less marginal the surgical defect following its excision may be repaired by application of the principle described in Chapter 21, Surgical Geometrics for the ablation of arched defects (See method of application in

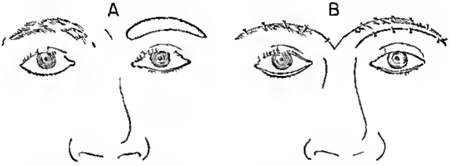

FIG 448 Coyane s method for the restoration of absent eyebrow (Beard) The uninjured eyebrow is split and rotated over to the region of missing eyebrow in the form of a flap Donor site is closed by direct approximation leaving donor eyebrow half its original width

usually the result of healed fracture depressions rather than actual loss of bone they may and can be reconstructed (if of moderate degree) by the use of auricular cartilage Where the derangement in the form of a depression is extensive it is usually best to reconstruct it by bone This may be accomplished by taking an osteoperiosteal graft from one of the clavicles The use of preserved cartilage in this connection has been fairly successful When used it must be imbedded subperiosteally or it may act as a comparatively loose body and be annoying A large number of derangements of the bony orbit are attended by soft tissue derangements These result in connection with ectropion of lower lid)

Where adhesions exist between the eyelid and the eyeball (symblepharon), they should be analyzed painstakingly in the hope that the condition can be relieved entirely by local flap reconstruction (Fig 452) Where this is not possible free grafting must be resorted to Oral mucosa or skin may be used

Derangements of the eyebrows are of many varieties including distortion displacements or misplacements The most frequently distorted segment of the eyebrow is the outer third or half (Fig 453) This implies replacement usually accomplished by an interchange of triangular flaps

in the form of a Z plasty (Fig 454)

General Over all derangement of the orbit is a complex problem having few equals It usually follows severe direct trauma attended by loss of the eye or the severe complication of double vision As with complicated jaw fractures if the case is seen early and not attended by skull fracture every effort must be made to replace at least the floor of the orbit if the eye is not hopelessly injured There is little

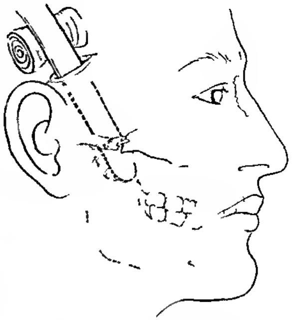

Fig 450 A method of elevating comminuted fracture of the zygomatic arch (Gillies) An incision is made in the temporal region down to and through temporal fascia An elevator is insinuated under fascia and slid down to below fracture deformity By pressure against elevator over a fulcrum zygoma may be repositioned Nothing more as a rule is necessary for maintenance of the arch

Fig 449 Roentgenographic position for visualizing defects of malar zygomatic compound (*Left*) Normal arch (*Right*) Healed deformity of left zygomatic arch

to be gained ultimately by ending up with a good eyeball in a functionally impossible orbit

The repair of a generalized derangement of the orbit is a radical piece of surgery which may involve all the problems and procedures enumerated under segmental derangements

Excesses

True Excesses of the orbit consist of such things as bony fatty or muscle hyperplasias and prominent eyebrows The management of an extensive or obvious eyebrow is a matter of calculated excision of its superior rim to an extent consistent with the needs of the case

False For the removal and the management of neoplastic conditions of the bony

FIG 451 (*Left*) Compound comminuted fracture of left maxilla with fracture of malar zygomatic compound and displacement of orbital floor downward Patient had double vision when seen 9 days after injury (*Right*) One week postoperative Intraoral buccal incision was made into left antrum floor of orbit and malar zygomatic compound replaced and Oxycel was packed tightly against floor of orbit (see text) This proved adequate splinting A wire loop was placed around zygoma and attached externally as shown Intraoral incision was closed Double vision disappeared in 3 days No complications

orbit the student is referred to textbooks on ophthalmologic or general surgery

LIDS (BLEPHAROPLASTY)

Voids

Total A total void of an eyelid may be either congenital or acquired The congenital type or ablepharon is a rare condition Nevertheless cases of blepharon have been reported in the past by E Fuchs (1885) Kuhnt (1899) Aubaret (1918) and a few other authors

Acquired total losses of the eyelids are relatively common particularly in warfare The method of reconstruction may follow any one or a combination of three basic procedures (1) the suturing of the unharmed eyelid into the raw surface of the defect left by the loss of its mate (2) by the importation of appropriate hairless tissues for both the lining and covering of the lid with subsequent insertion of fascia or cartilage for support (3) by the use of full thickness segments taken from the root of the helix as reported by C J Armstrong in connection with the lower eyelid The first procedure is a relatively mutilating one in that it partially destroys a good lid in order to aid in the reconstruction of a missing lid By suturing the good lid into the traumatic defect it is allowed to remain until it stretches to an extent where it can be split horizontally into two lids

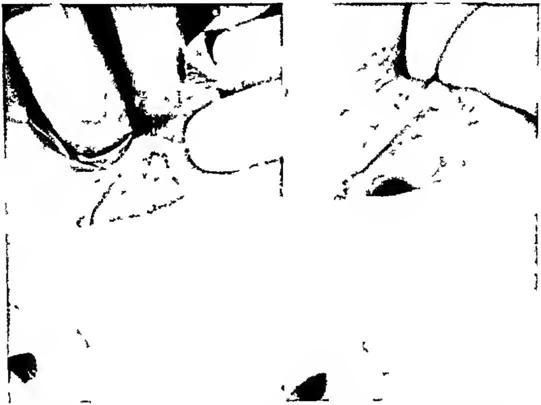

FIG 452 Extensive adhesion of upper lid to eyeball (*Left*) Preoperative (*Right*) Postoperative Reconstitution of the lining of upper lid was accomplished by rotating flaps of the uninvolved conjunctiva across defect remaining after excision of scar tissue

Reconstruction by *means of tissue impor*tation is best accomplished by tissues collateral to the defect This may be done by lining the desired amount of skin and subcutaneous tissue in the vicinity of the defect with a split free graft and then rotating migrating or swinging the lined flap across the defect and suturing it into its nasal aspect (Such a reconstruction is incomplete until the ciliary margin is supplied) A lined double pedicle horizontal temporal flap swung medially over the defect, is a good example

Where an adequate amount of lining is present within the orbital cavity to allow for its advancement outward the entire lid may be reconstructed by superimposing upon the former a full thickness skin graft In the case of a lower lid this may be taken from the upper lid either on the same or the opposite side Where this method is em*ployed a tarsorrhaphy is necessary between* the uninjured and the new lid

In partial losses of the lid and particularly the lower full thickness ear sections would seem to be logical It is rather doubtful whether an entire lower lid could be reconstructed by this method without obvious mutilation of the donor auricle This might be circumvented by using smaller appropriate segments from both auricles Auricular cartilage is too thick for fine results

Partial Partial losses of the lid may be segmental regional or thickness losses The most frequent are voids of the skin covering The regional losses may be subdivided into canthal ciliary or the lid proper

Canthal voids usually can be reconstructed from local tissues by rotation and advancement or some type of limited tarsorrhaphy Absence of the eyelashes can be

FIG 453 Most common type of derangement of the eyebrow (displacement of outer half of eyebrow upward) This can be corrected by a Z plasty in which eyebrow forms one of the triangular flaps of the Z as indicated in the photograph The flaps are transposed after undermining

restored satisfactorily by a method reported by Schuessler and Filmer The restoration as recommended consists in the mobilization of approximately a 3 mm wide free hair bearing graft excised vertically from the eyebrow and sutured into a properly prepared recipient bed on the rim of the eyelid

Voids of the main body of the eyelids may be either congenital or acquired The congenital type known as microblepharon consists of the absence or adequate vertical height of the lid Another congenital condition more often seen than microblepharon is the so called coloboma Like the acquired type this can usually be corrected by the inshifting and rotation of collateral tissues with readjustment of the lining of the lid The easiest type of geometric surgical defect to correct is the triangular or notch type of void Making an oblique incision lateral to the outer canthus so that it is more or less parallel with the lateral lip of the void allows for the medial shifting of a flap in the form of a parallelogram The secondary defect can then usually be closed by undermining and approximation This is in essence an original Dieffenbach procedure (See Chap 21 Surgical Geometrics) If the surgical defect following excision of the void is in the form of a square or oblong it may be repaired by designing a rectangular flap lateral to the external canthus and advancing this over the region of the lid Where the partial void of a lid is a major one involving more than half of the appendage the latter procedure may still be used but necessitates a relatively extensive flap which is difficult at times to advance in one step In such a case the principle of caterpillaring is resorted to This implies two surgical innings but allows for a safer transportation and more accurate apposition of the necessary amount of skin without the possibility of a lateral pull which can result with the inshifting of an extensive rectangular flap (For principle of caterpillaring see Plate 4)

Whether the partial void of a lid is a coloboma one of the canthi or of the lid proper many procedures are available which cannot all be detailed within the scope of this book and yet each one has its more or less specific application All may be reduced to 8 categories as follows those which are based upon the advancing of the available lid tissues and suturing thereof in layers the Mirault procedures essentially applicable to defects of a notched type Wheeler s halving procedure Dieffenbach s method of sliding of a rectangle into a triangular defect the procedure of Celsus consisting of the approximation of two sliding quadrangles one medial and the other lateral Tripier s procedure for skin loss of a lid which consists of the hammock flap taken from the uninjured and usually upper lid a modified Stein Estlander Abbé procedure described in con

Fig 454 (*Left*) Unavoidable displacement of eyebrow because of the necessity for closure of extensive compound injury to the right orbit Note derangement of hairline (*Right*) Entire eyebrow replaced in its normal position by Z plasty Note replacement of hairline by employing the same procedure

nection with lips or the essentially American method of free grafting defects of the lids

Derangements

Derangements like partial voids of the lids may be regional, segmental or thickness defects of the appendages In addition to these, there are the derangements resulting from innervation of the lids involvement of the muscles of the eyeball and adhesions of the eyelids to the eye itself

Canthoplasty Canthal derangements are those of form or position The outstanding formative derangements are those where the canthus is too small or too large In the former case canthotomy is the simplest remedial procedure In the latter a partial tarsorrhaphy may be adequate Displacement of the canthus laterally is usually remedied by a V to Y closure Where the canthus is displaced upward or downward it may be replaced by a Z plasty This is accomplished basically in more or less the same manner as described in connection with the replacement of the corner of the mouth

Chalinoplasty Scars and contractures of the lids so frequently the result of burns (Fig 455) are remedied by excision of the scar tissue and repair of the surgical defect by methods already enumerated under partial voids For the most part this consists of sliding flaps or the implantation of full thickness free skin grafts whose donor site may be one of the upper lids the skin

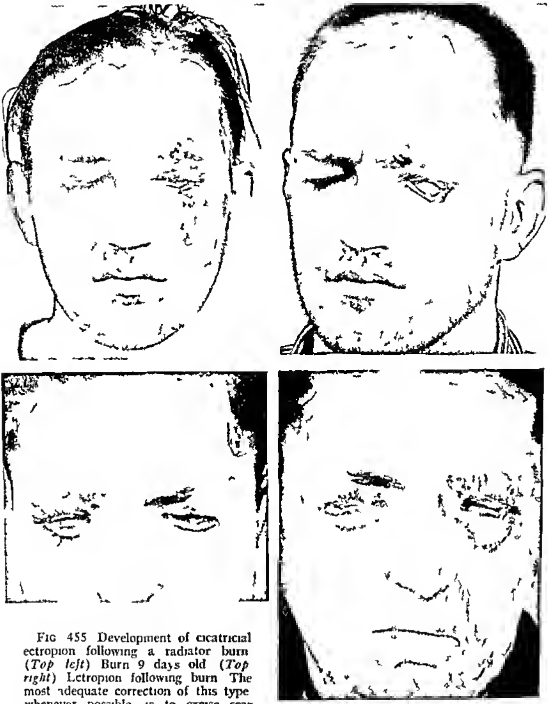

FIG 455 Development of cicatricial ectropion following a radiator burn (*Top left*) Burn 9 days old (*Top right*) Ectropion following burn The most adequate correction of this type whenever possible is to excise scar tissue and to rotate collateral flaps of skin across surgical defect Barring the latter see below (*bottom right*) (*Bottom left*) Bilateral cicatricial ectropion of all four eyelids following flash burn of face (*Bottom right*) Method of repair via *thin* full thickness skin grafts from area such as the region under the upper arm Note tarsorrhaphy This is imperative to avoid shrinkage of graft It should be maintained for a minimum of 3 or 4 months

from the postauricular region or from the supraclavicular region.

Displacements of the lids consist essentially of ectropion and entropion. This may be cicatricial, paralytic, atonic (senile), regional or total. It is correctable by a large number of procedures, the choice of which depends essentially upon the type, location and extent of the lid eversion. If the ectropion involves the outer third of the lower lid, one of the best procedures is Denonvilliers' operation, which is a modified form of the "Z"-plasty (Fig. 456). Where the eversion involves the middle third of the lower lid, it may be correctable by the Wharton-Jones' or by the "V" to "Y" procedure. This is not always a satisfactory procedure. A modified "Z"-plasty, sometimes referred to as the Lagleyze's procedure, is more dependable and leaves a less obvious scar. The same type of correction can be obtained with far more accuracy by applying the pleating procedure (described in Chapter 21, "Surgical Geometrics") for the closure of arched defects. This is accomplished by making a horizontal incision just below the rim of the lower lid, undermining the skin of the lid widely, pleating the latter in a medial direction if possible, incising under the pleat and thus forming the two triangular flaps, as illustrated in Figure 457 and discussed in Chapter 21, "Surgical Geometrics."

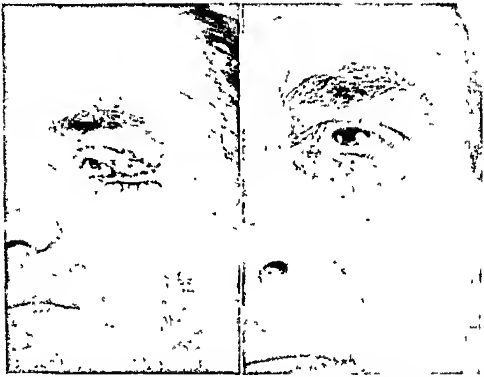

FIG. 456. (*Left*) A procedure for the correction of ectropion of the outer half of the lower lid (Donenvillier). A triangular flap, pedicled lateral to the outer canthus, is mobilized from the upper lid and rotated downward, where it is embedded in a defect resulting from excision of scar tissue and repositioning of lower lid to its normal level. Note that in this case a single suture tarsorrhaphy was performed. (*Right*) Same patient, 1 year postoperative. Note correction of ectropion.

Where the condition is due to paralytic, senile or atonic condition of the tissues, as evidenced by descensus, looseness and loss

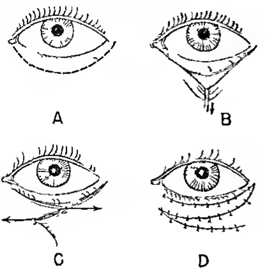

Fig 457 Pleating procedure for correcting extensive ectropion of the lower lid (cf Chap 21) (A) Placement and extent of incision indicated by broken line Stippled area indicates extent of undermining (B) Initiation of procedure by placing hook retractor at mid point of undermined lip and pulling skin away from underlying tissue (C) Pleating of undermined lip in preparation for incision (indicated by broken line) which allows for unfolding of pleat and creation of triangular flap When opened and laid down upon remainder of undermined lip this delineates second flap (D) Method of transposing flaps and closure Stippled area beyond end of upper flap illustrates original length of flap and actual length used by amputating some of the upper flap in order to put it on slight degree of stretch This helps to maintain close contact between new lid and eyeball and also level of ciliary border of lid

of elasticity of the mucosal lining of the lid a layer to layer reconstruction is necessary This is accomplished by excision of the required amount of the lining of the lid in the form of a wedge and its reapproximation so that a normal relationship is re established between it and the eyeball

Where ectropion of the upper lid is associated with cicatricial displacement every effort should be made to remedy the situation by collateral flaps (Fig 458) This avoids the need for prolonged tarsorrhaphy guarantees better function and results in the best esthetic appearance

Entropion may be classified as cutaneous tarsal full thickness or adventitious Where the entropion is of a very moderate degree partial excision of the lid with eversion of its margin may be adequate to answer the problem Where the inversion is more severe an operation like the Hotz Anagnostakis procedure based upon the excision of some of the fibers of the orbicularis oculi muscle may be employed Where the Hotz Anagnostakis operation would seem inadequate direct attack upon the tarsal plate may be employed This consists of a wedge shaped excision of the plate including the overlying orbicularis muscle and rotating the free rim of the eyelid upward This is maintained by mattress sutures entering and exiting through the intermarginal border behind the cilia after being looped through the cut lower border of the tarsus

General Total cicatricial ectropion of the lower lids with injury to collateral tissues precludes any thought of local repair and must therefore be remedied by the implantation of full thickness free grafts A tarsorrhaphy must always be done in these cases and maintained for three to six months (see Fig 455 *bottom*)

A common condition belonging among derangements of the lids is blepharoptosis This may be congenital or acquired It is sometimes difficult to differentiate between the two According to Edmund B Spaeth from the standpoint of its correction congenital ptosis still continues to be the step child of ophthalmology It is due to congenital maldevelopment of the levator and the superior recti muscles in connection with aberration of their innervations There are innumerable operations for the management of congenital ptosis These may all be reduced to three basic ones the use of

FIG. 458 (*Left*) A type of derangement of upper eyelid and eyebrows due to partial traumatic loss and avulsion Note absence of outer half of eyebrow (*Center and right*) Four months postoperative Revision accomplished by excision of scar tissue and in-shifting of collateral flaps which were crossed over surgical defect Note repositioning of right eyebrow and the ability to shut the left eye.

the superior recti muscles, shortening of the levator, or the use of the occipitofrontalis in the form of muscle strips. The student is referred to current texts on ophthalmological surgery for details in connection with these procedures

Acquired forms of blepharoptosis are frequently due to an excess or redundancy of tissue following injury or surgery These cases (and also the congenital type) must not be confused with certain cases of apparent ptosis of the lids which are due to metabolic or other general conditions In the mild true traumatic or acquired types, excision of skin with a chosen amount of tarsal cartilage, followed by meticulous apposition, may be sufficient to produce an adequate result Where the traumatic condition necessitates excision of unusual amounts of tissue, compensatory procedures consisting of a frontalis muscle flap, skin flaps, fascia strips attached to the frontalis muscle are employed as supports or slings The use of inanimate material such as tantalum wire is sometimes recommended. but, in view of recent advances in reconstructive surgery the method seems plebian

Another common condition very often brought to the attention of the plastic surgeon is the retracted or recessive upper eyelid. This is frequently due to atrophy of retrotarsal tissue and may be corrected by the insinuation of additional cartilage support into the upper lid, or fascial strips which span the horizontal extent of the lid or both The implantation of acrylic supports for the upper lid as recommended by some authors is discouraged It is not necessary and contrary to the physiologic principles of reconstructive surgery

A legion of other tissue derangements, such as trophic absorption of orbital tissues, prolapsed eyeball and pigmentations, are found afflicting the eyelids It is not possible in a general text to discuss them all, although methods of correction are indicated by illustration

Excesses

True The most outstanding true excess of the lids is blepharochalasis or redundancy of the skin of the lids This is usually corrected by the excision of the proper amount of skin and at times some of the fibers of the underlying orbicularis Where this procedure is used one must use caution cision of the superfluous tissue with inshifting of pedicled flaps or the free grafting of the surgical defect is the only solution (Fig 459)

False The most common false excesses are xanthelasma cysts nevi carcinoma and melanoma The latter will be discussed in Chapter 38 Skin With the exception

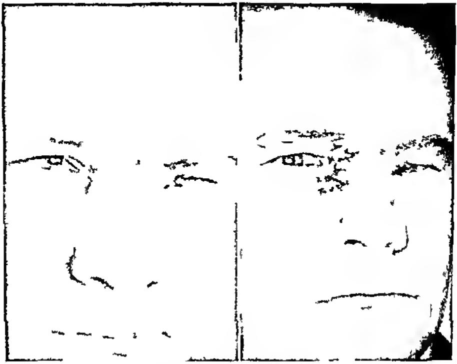

Fig 459 (*Left*) Extensive epicanthus over right eye (*Right*) Method of correction by double Z plasty

not to excise too much of the skin lest the operation result in ectropion

Epicanthus occurs not infrequently This may be either congenital or acquired and consists of a fold of skin or scarred tissue in the form of a wing obstructing the region of the inner canthus and running from the side of the nose down to the lower lid The congenital type of epicanthus may be resolved by means of a Z plasty or better still by the Blair procedure The cicatricial or acquired type may be resolved by a multiple Z plasty At times complete ex-

of carcinoma and melanoma the others are amenable to simple excision and appropriate closure of the surgical defect The eradication of the melanotic and malignant types of tissue excesses of the lid usually implies radical excision and consequently total reconstruction of the appendage (cf Total Voids) Where the lesion is sensitive to radiotherapy and the latter is employed great care must be exercised in avoiding injury to the eyeball Even so radiotherapy frequently results in obvious distortion of the eyelid and therefore may have to be

followed by some type of reconstructive surgery

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38

Skin (Dermoplasty)

Injuries and defects of the skin per se obviously are not only the most commonly seen by the general surgeon but are an important responsibility because of the possibility of eventual scarring and deformity of the injured skin Much of the experience accumulated in connection with the care of the skin in the form of grafts may well be applied to the care of the traumatized skin

VOIDS

Total Voids

Total voids of the skin per se from a practical standpoint imply full thickness loss of the tissue Avulsions and deep ulcerations are outstanding full thickness losses

Avulsions may be complete or incomplete The former are those where a quantity of skin is accidentally separated from its underlying tissues and completely and absolutely divorced from any circulatory contact with its original site The second type is that where there still exists some connection (peduncle) between the avulsed tissue and its original bed The latter may be subdivided into incomplete, proximal and distal avulsion depending upon the location of the peduncle with reference to arterial supply This subclassification is important in the treatment ultimate course and fate of the skin

Complete avulsion of the skin does not necessarily mean final loss When skin is avulsed from its site of origin it usually carries with it some of or all the subcutaneous fatty tissue Occasionally such avulsed portions of skin are brought in by the patient or some interested person in the hope that it may be replaced This is not an empty hope A piece of detached skin covered by its subcutaneous fatty tissue is of more practical interest from a surgical standpoint than skin detached without the fatty layer The former if not too badly lacerated or contaminated should be thoroughly scrubbed in soapsuds and then thoroughly washed in saline Thereafter the subcutaneous fatty tissue should be cut away from the skin proper with a pair of Mayo scissors curved on the flat It is advisable to take the lowermost layer of the derma with the fat

This accomplished the skin proper may then be sutured back into the wound in the same manner as a full thickness free skin graft This may be risked because whereas the soiling and contamination of the epidermal side of the skin can be as thoroughly scrubbed with soap and water as the skin of the surgeon's hand the presence of the fatty layer on the skin—being the one actually contaminated—when removed under aseptic conditions bids fair to leave the derma clinically clean Excision of the fatty layer should be accomplished by taking off thin sheets rather than excision of the fat en masse and by changing scissors with every deeper cutting thus avoiding recontamination of the derma by the original scissor used in the excision of the contaminated outer layers of the fat Once the skin proper has been sutured into its original bed, it must be managed postoperatively in the same way as a full thickness free skin graft In addition the patient should receive the benefits of chemotherapy

The problem is always an important one

FIG 460 (*Left*) Method of primary closure of lacerations of the cheek Note deliberate incision into lips of laceration in order to mobilize flap for upper lip where tissue was lost in accident (*Right*) One stage closure of extensive cheek defect following excision of large amount of scar tissue The wide scar ran in practically a straight line from inner canthus and zygoma to corner of mouth Note insinuation of small triangular full thickness free skin graft under lower lid to avoid tension thereon by forced approximation of oblong flap from lateral side of cheek (see also Fig 53)

as to what to do with the avulsed skin which in some degree is still attached to its site of origin If the attachment is proximal in other words hinged to the arterial supply of that skin region and if the length of the avulsed portion of the skin does not exceed 2½ times the width of its attachment the entire avulsion after proper aseptic preparation may be sutured back into place with a fair degree of success Where the avulsion exceeds 2½ to 3 times the width of its attachment the skin may still be saved and used to resurface the wound by excising all of the subcutaneous tissue as indicated under complete avulsions and then by replacing the skin proper in the form of a full thickness skin graft

Where the incomplete avulsion remains attached only by a distal hinge or to the essentially venous supply of that skin area there is little hope of its survival—even though its length may be less than 2 to 1 as compared with the width of its attachment—unless all of the subcutaneous tissue is immediately removed and the skin proper replaced in the form of a full thickness graft In the latter case the postoperative management is the same as indicated under incomplete proximal avulsion

Ulcerations An ulcer never should be grafted until its nature has been determined wherever this is possible otherwise one is instituting treatment before having made a diagnosis This diagnosis should include not only an investigation of the patient s general condition but a thorough appraisal of the tissues about the ulcerating area Both are important in determining the specific type of therapy Even though ulcerations due to general pathology may heal with improvement of the general condition if the tissues about the ulcer have reached

FIG 461 (*Left*) Radodermatitis of 22 years duration Note extensive atrophy and pigmentation of skin as well as beginning neoplasia above the suprasternal notch Patient suffered unbearable itching (*Right*) Method of correction via extensive shoulder girdle flaps after excision of entire affected neck area in one surgical inning The two lateral flaps are from the acromioclavicular regions and the two medial flaps from the infraclavicular regions on each side Itching ceased An early postoperative photo is shown to illustrate outline of flaps (see also Fig 54)

a stage of obvious sclerosis the cure of the general condition may not in itself be adequate to dispose of the lesion In other words the circulation and the innervation of the tissues about the ulcer may have been so jeopardized by delay that epithelial regeneration and healing remain out of the question

In such instances the ulcer will have to be excised and the defect grafted But the tissues about the ulcer afflicted with sclerosis must also be excised before the application of a graft Otherwise the bed for the graft remains inadequate because it is unphysiologic and the graft will be lost in part or in whole *The time loss and tissue* cost in such cases is too high to warrant disregard of this principle

PARTIAL VOIDS

The most frequently seen partial thickness voids of the skin are abrasions and second degree burns

Abrasions may be divided into uncontaminated contaminated and tattooed Treatment is influenced by these factors Notwithstanding at no time should tincture of iodine ether or any form of chemical irritant be applied to any abrasion

The uncontaminated abrasion may be

FIG 462 (*Left*) Extensive radiodermatitis with sclerosis of skin involving cheek and left jaw (*Center*) Complete excision of involved area in one surgical inning and immediate coverage by extensive Z plasty performed according to plan for closure of arched defects (Chap 21) Three weeks postoperative (*Right*) Final result 5 months postoperative

covered by sterile or fiberglass gauze and bandaged after adequate cleaning with soap and water The contaminated abrasion must be thoroughly cleaned with soap and water and meticulously irrigated by saline It should then be dried and carefully inspected with a magnifying glass to remove all minute foreign bodies present It should then be reirrigated copiously with saline and covered in the same manner as the uncontaminated abrasion These injuries should not be covered by greasy dressings because *such dressings only help to create a closed* moist space an ideal situation for the development of a superficial infection

The tattooed abrasion should be handled basically in the same way as the contaminated one It never should be scrubbed with the vigor usually recommended this only adds additional insult to an already traumatized skin and too frequently results in epithelial scarring Although it takes patience and more time to pick out the tattooing foreign bodies or debride the bits of tissue where the former is not practicable the ultimate esthetic results are far better Where the tattooed spots are deep scrubbing certainly will not help If these are not too large or too numerous it is far better to excise them or carefully touch them with a phenol pencil The pencil touch usually results in exfoliation of the tattooed epidermis or the outer layers of the derma with considerably better healing than if the area is traumatized by severe scrubbing

Second degree burns should be protected from unwarranted surgical meddling too early removal of blisters and the application *of irritating chemicals* When the blisters are fully formed they should not be aspirated as long as their serum content is clear When this shows signs of bacterial growth the epidermal coverage of the blister must be removed If the underlying derma is a grayish white one is actually dealing with a third degree burn and the area should be handled accordingly In due course of time the deathly gray underlying derma will slough Where the latter is pink after the removal of the blistered epidermis one is obviously dealing with a second degree burn and the raw area should be

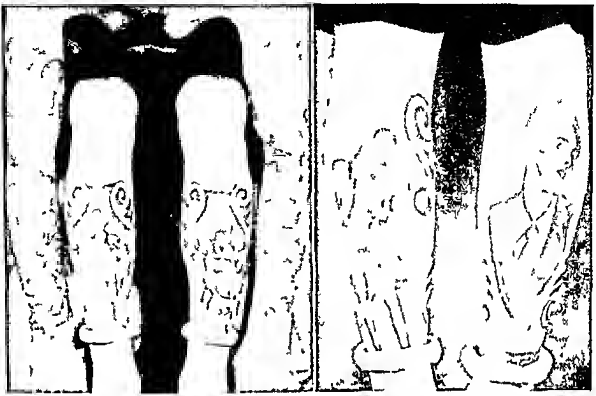


Fig 463 Extensive tattooing of arms and legs impossible to remove without complete excision and free grafting There is not sufficient untattooed skin on any of the extremities to indulge in partial repeated excision In this patient the problem was impossible because much of his torso, including genital organs were just as heavily tattooed

handled in the same way as a clean abrasion (see Figs 91 and 92)

DERANGEMENTS

Segmental

Tissue derangements affecting the skin are many, but only those will be discussed which are of daily interest to the surgeon and the general practitioner

Contusions Little is said of the necessity for pressure dressings and the use of cold in the treatment of contusions When these are expertly applied it is usually adequate treatment for the average contusion Cold never should be troublesome unless the consequences of the contusion are allowed to develop These include superfluous extravasation of serum into the contused tissues or hemorrhages into the skin Both may be avoided by the application of cold *and pressure* This is a *form of splinting* and splinting is all that is necessary in the treatment of contusions

Lacerations Obviously a skin laceration must be treated with the same precautions as any other open wound The unplanned closure of a skin laceration by simple suture approximation is not always good treatment A segmental analysis of the laceration should be made as indicated in a previous chapter so that the original repair of the wound is consistent not only with accurate repositioning of the various segments of the injured skin but also with consideration for the lines of tension of the organ and its influence upon consequent scar formation If the laceration runs across the lines of tension of the skin this must be taken into account immediately and provision made against scar contracture or skin retraction by secondary incisions into the lips of the

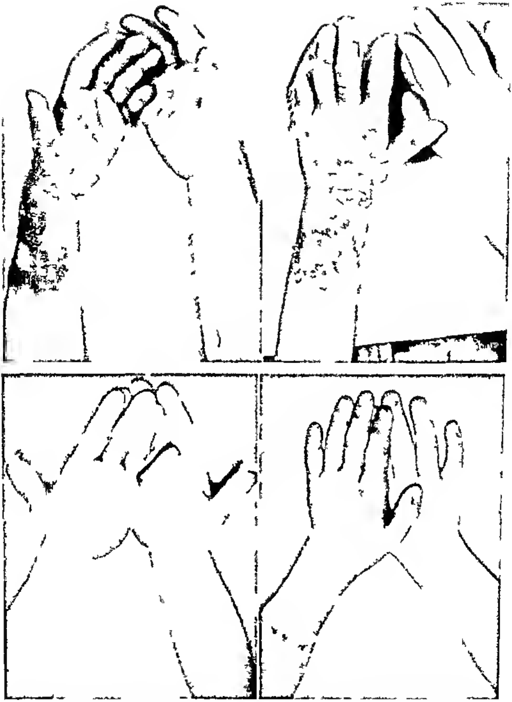


Fig 464 (*Top*) Congenital nevus involving hand and distal half of forearm of child 3 years old Small light oval areas in nevus resulted from the application of carbon dioxide snow shortly after birth Note that partial bleaching of areas did not change verrucous appearance of skin and growth of hair (*Bottom*) The afflicted skin of the entire dorsum was removed in one stage and free grafted The volar aspect of the extremity was grafted separately later Note retraction of full thickness graft from fingernails and stretching of peri ungual skin which at time of operation was left only wide enough to insert suture needles through it

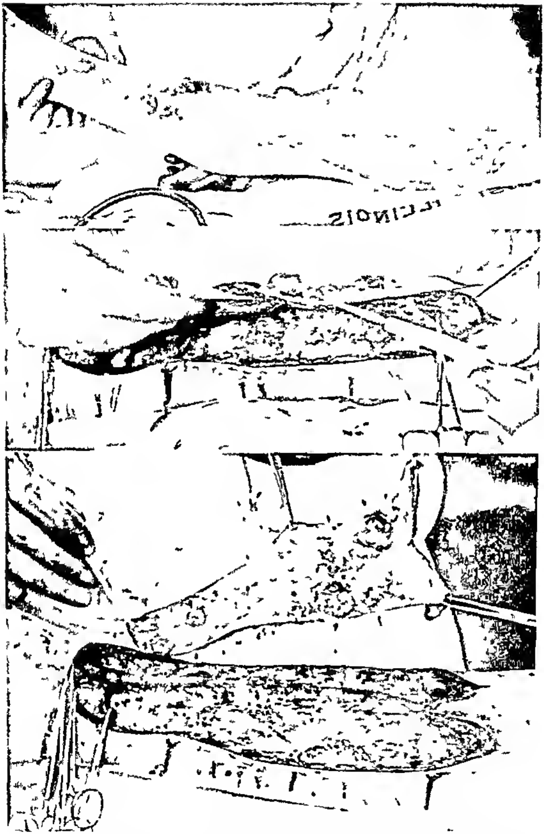


FIG 465A (*Top*) Example of malignant degeneration within the confines of a "nevus lineus" Pathologist's report "slow growing carcinoma of the skin" (*Center*) Complete excision of the skin area involved by neoplasia Note communicating blood vessel between large tumor on skin and deep muscle tissue underneath Every one of the skin tumors had a communicating vessel to it (***Bottom***) Amount and kind of tissue excised

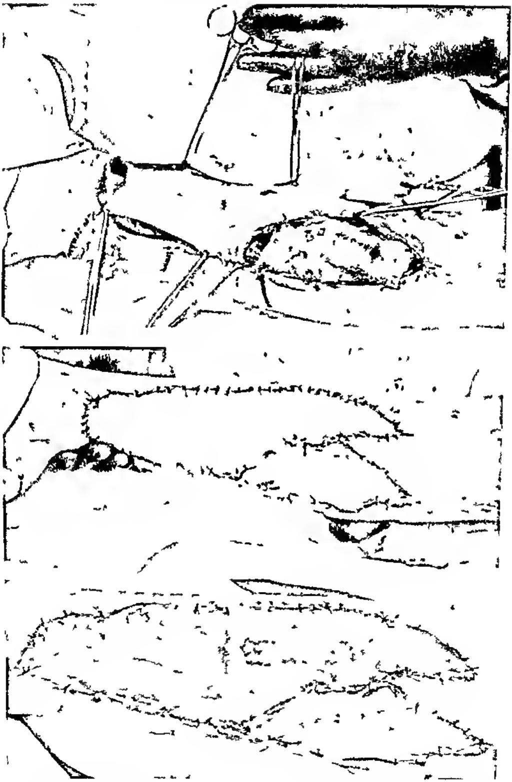


Fig 465B (*Top*) Application of thick split graft mobilized with Padgett dermatome from contralateral thigh (*Center*) Grafts sutured into position The smaller skin graft in the upper angle of the wound was cut freehand Note grain in the large split graft due to excursions of blade of Padgett dermatome (***Bottom***) Appearance of free skin grafts at time of first dressing and removal of sutures (see Fig 465C)

laceration as outlined under "Wound Closure" (Fig. 460). The ultimate closure of such a laceration may look somewhat different from the original wound but will result in a better quality of scar and much less postoperative embarrassment of the affected part through tension and contraction (see Chaps. 15 and 21; also Fig. 198).

Radiodermatitis. Although less common now, the bad consequences of radiotherapy still occur. They are the result of the effect of irradiation upon the blood and nerve supply of the skin and subcutaneous tissue. This results in obliterative endarteritis, nerve changes and scarring which leads to atrophy, symptoms of itching, burning and discoloration sometimes intolerable to the patient.

Radiodermatitis in its more chronic manifestations may be divided into the metaplastic and neoplastic types. In the metaplastic type, as evidenced by discoloration, atrophy of the skin and subcutaneous tissue, dryness, scaling, the recurrent formation of bullae (either clear or hemorrhagic) and severe subjective symptoms of itching or burning, the affected skin should be excised well beyond the area obviously affected and the surgical defect repaired by skin flaps. In the neoplastic type showing signs of malignant metamorphosis, there can be little argument as to the rationale of complete excision of the affected tissues. In neither type has the application of the free skin graft proven very successful

Fig. 465C. (*Top*) Appearance of free split grafts two months postoperative. (*Right*) Appearance of grafted leg 1 year postoperative.

Therefore, it should not be used except in self-defense A full thickness skin and subcutaneous tissue covering is the only reliable form of surgical therapeusis (Fig 461)

The surgical defect remaining after the excision of skin affected by radiodermatitis is never a good bed for grafting This is due to the fact that the extensive endarteritis precludes an adequate circulatory supply for the graft Therefore, this supply must bring with it its own circulation in order to have any chance of success Hence, every effort should be made to bring into the defect flaps or tubes which have only the most reliable blood supply (Fig 462)

Miscellaneous Such defects as scars, tattoes lupus vulgaris, and others have been discussed in previous chapters (Fig 463)

General

With the exception of a generalized second degree burn gone on to scarred healing (a theoretical and academic concept) general derangements (psoriasis, vitiligo alopecia, etc) are of essentially dermatological concern Only if they are regional or segmental may they be of interest to the plastic surgeon

EXCESSES

True

True excesses of the skin are usually of congenital origin Where the condition is obvious or troublesome the redundant skin may be ablated by planned excision, in accordance with function of the part, appearance and possible scar formation

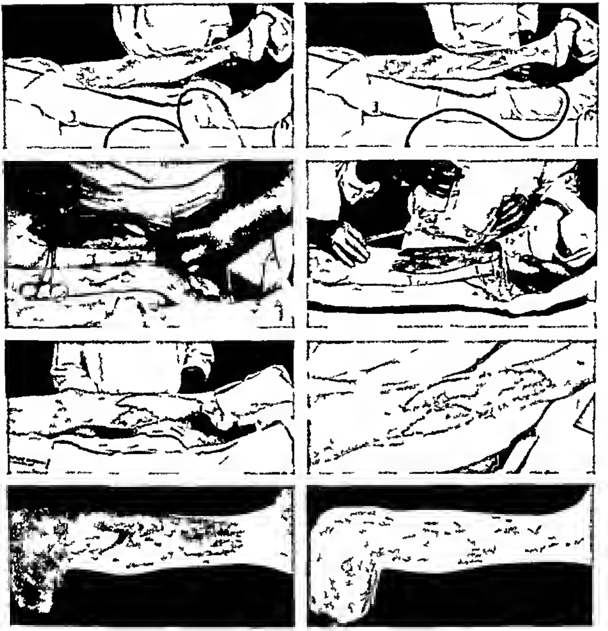
False The tissue excesses which come to the general surgeon are keloids (Fig 158), nevi (Figs 464 and 465) xanthomas, basal cell carcinoma, the field fire" carcinoma of Brown and McDowell cysts, lipomas, basal squamous epithelioma, Kaposis' carcinoma, fibromas and others (Fig 466) The only thing of importance in this connection is that these lesions be completely excised and that the excision should be planned, not disregarding good functional and formative skin closure Obviously, this is a secondary consideration in malignancies Nevertheless, some type of reconstruction may have to be done later on and this may be made easy or difficult, depending not only upon the amount of tissue originally excised but the quality of the closure Much can be gleaned by the student in this connection by reviewing the principles discussed in Chapters 12, 15, 18 and 21

There are other conditions affecting the skin which are now more often referred to the plastic surgeon than before These are dermoptoses, hirsutism, malignant melanoma and others The wrinkling and sagging of skin and its management has been discussed in Chapters 30 35, and 37

Hirsutism Surgical treatment of superfluous hair resolves itself into excision of the affected skin and some type of closure Where this is indicated it is best accomplished by partial repeated excision of the area and direct apposition of the skin edges Such procedures as removal of the subcutaneous fat undermining of the skin in the hope of destroying the hair follicles and others are not recommended because they are not only unsuccessful, as a rule, but esthetically deforming The use of the electric needle is usually too tiring to the patient whereas the application of radiotherapy is a matter whose decision rests entirely with the conscience and qualifications of the radiotherapist

Malignant melanomas, as a rule are not very radiosensitive and hence are frequently referred to the plastic surgeon for excision They are rapidly fatal tumors once they begin to metastasize and are often not easy to diagnose Whereas surgical treatment of this condition is too frequently meddlesome in other instances it is considered hopeless therefore, the proper management of these conditions remains confusing in the student s mind

Experience thus far throws its weight decidedly in the direction of radical surgical



Surgical management of extensive cutaneous lesion (*Top left*) Extensive congenital pigmented nevus of the left lower extremity with malignant degeneration in leg area (*Top right*) Scalpel outline of the area destined for excision (*Second row left*) Malignant area in the process of excision Note malignant (microscopically proven carcinomatous) nodules and the fact that each one has a blood vessel (perforating vein) leading to it (*Second row right*) Excision of lesion completed Note the depth of the excision including perforating veins and the distinct multicolored pigmentation of the nodules (*Third row left*) Surgical defect is covered by two free grafts the larger (0 022 in thick) was cut by Padgett dermatome The smaller was cut freehand This gives opportunity for observation of two types of free grafts (*Third row right*) Condition at time of first post operative dressing (12 days) Note sloughing of epidermal layer of the larger and thicker graft This is frequent in full thickness free grafts but has little effect on the final integrity of the graft (*Bottom left*) Grafted leg 10 weeks postoperatively Note appearance of a new nodule over tibia and just above the grafted area Also observe inferior terminus of the healed incision distal to trouser cuff This is the result of extirpation of the femoral and inguinal lymph glands at time of the original operation Gland biopsy was negative (*Bottom right*) Same leg shown at left one year postoperatively Note that the nodule has been excised and that in its vicinity 2 small ones are reappearing This led to eventual total excision of the nevus and replacement by a one piece full thickness free skin graft The patient has had no recurrences 2 years after the second operation

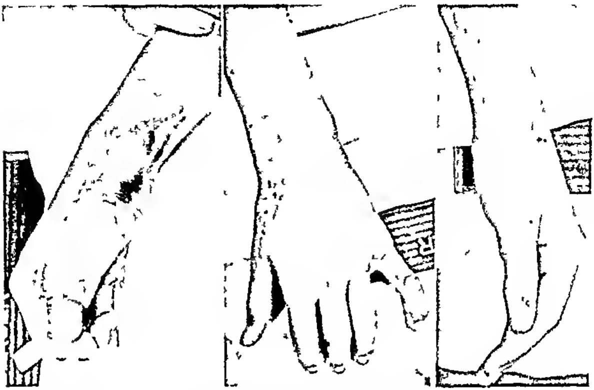


FIG 466 (*Left*) Extensive bilateral verrucous lesion of left hand and forearm (*Center*) Showing extent of free full thickness skin graft applied to radial side of forearm and hand after excision of lesion Donor site, abdomen Time, 30 days postoperative Lesion on outer side of hand and forearm still to be excised and replaced by free full thickness skin graft (*Right*) Profile of free full thickness skin graft, 40 days postoperative

extermination of the lesion Thoroughness in this connection cannot be overemphasized This must *be done even at the expense of possibly deforming or ablating the part* or appendage If the melanoma involves such regions as the cheek, it may even be necessary to sacrifice such important structures as the facial nerve Where malignant melanomas occur about the mouth the cheek or any part of the face drained by the cervical lymph nodes, regional gland dissection of the neck should be done It is a prophylactic measure recommended by most surgeons who have had any experience with this type of lesion It is far better that the patient lose the lymph glands of his neck, even though signs of metastasis are not present or to be demonstrated beyond a shadow of a doubt, than to lose his life because of the lack of courageous and experienced judgment

Obviously, where such *radical surgery must be performed in spite of the relative* smallness of the lesion, the surgeon charged with responsibility should be well grounded in the more extensive procedures of plastic surgery Often the closure of the excisional defect may not be possible by rotation flaps or simple shifting of tissues In such instances a 'caterpillar' flap should be prepared before excision and shifted into the defect at the time of extirpation of the lesion (Plate 4) On the whole, this procedure is more applicable in the excision of benign lesions

The over all experience with melanomas, as gleaned from contemporary literature, may be summarized as follows

One out of approximately one million pigmented moles is a malignant melanoma when first encountered

One out of approximately 2 000 pigmented moles is potentially malignant—the growth potential of the cells going to activity upon irritation

All pigmented moles are apparently subject to malignant metaplasia if irritation becomes adequate

No pigmented mole should be subjected to or irritated by irradication cautery freezing or probing

Excision of a pigmented mole should consist of radical ablation of all tissues in depth down to and including the deep fascia and in width sufficient good skin about the lesion so the latter is at least equal in breadth to the thickness of the excision

All excised pigmented moles should be examined microscopically

All microscopically proven malignant melanomas should be followed by radical ablation or amputation of the part appendage or extremity as the case may be

All melanomas proven microscopically malignant should be followed within 20 to 30 days by regional dissection of lymph nodes

Inadequate excision of an originally malignant melanoma may be followed by recurrence even 20 years postoperatively

Pending more exact knowledge of the pigmented mole it should be routinely avoided in every way as concerns any form of irritation widely excised following single trauma infection or the slightest suspicion of malignant metaplasia as evidenced frequently by pseudopodial extension of pigment through its original circumference Use micro inspection (Fig 14)

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